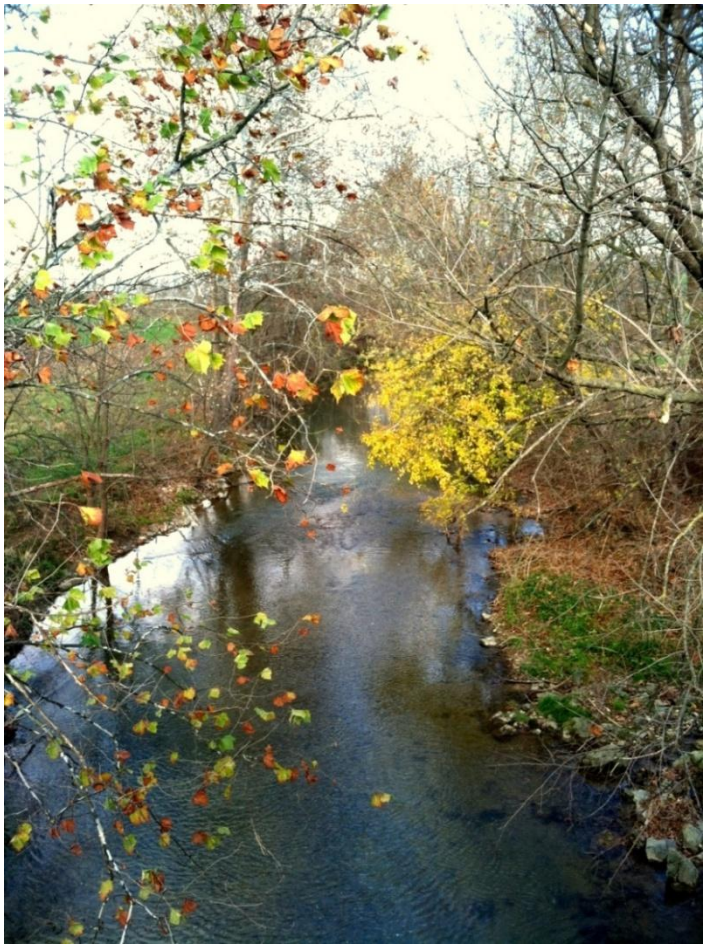
Linville Creek Watershed Implementation Plan (Bacteria and Sediment TMDL)

Technical Report



Prepared for: Virginia Department of Environmental Quality
September 27, 2013

Submitted by:

MapTech, Inc.
3154 State Street
Blacksburg, VA 24060

page intentionally blank

CONTENTS

FIGURES

TABLES

ACKNOWLEDGMENTS

Steering Committee Members

Working Group Members

Shenandoah Valley Soil & Water Conservation District (SVSWCD)

Natural Resource Conservation Service (NRCS)

Rockingham County Department of Health

Linville Edom Ruritan Hall

Virginia Department of Environmental Quality (VADEQ)

Virginia Department of Conservation and Recreation (VADCR)

Local citizens and stakeholders in the Linville Creek watershed

MapTech, Inc. of Blacksburg, was supported in this study
through funding provided by the
Virginia Department of Conservation and Recreation

Individual summaries of this document for the Linville Creek watershed are available from the Virginia Department of Environmental Quality.

page intentionally blank

EXECUTIVE SUMMARY

Linville Creek is located in Rockingham County, Virginia. It was originally listed as impaired in 1998 from its headwaters to its confluence with the North Fork Shenandoah River, 13.49 miles downstream. It was impaired for not supporting the recreation/swimming and aquatic life uses.

These listing were due to violations of the State's water quality standards for fecal bacteria and the general water quality standard. This means that the stream does not support the primary contact recreation use including swimming, wading, and fishing due to an increased risk of illness or infection when coming in direct contact with the water. The fecal bacteria *E. coli* standard specifies that in-stream *E. coli* levels must not exceed a single sample maximum of 235 cfu/100 mL or a geometric mean of 126 cfu/100 mL. As a result of the impairment listings, and court actions taken against the United States Environmental Protection Agency (EPA), total maximum daily load (TMDL) study was developed in the Linville Creek watershed and approved by the USEPA in 2004. The study established the reduction in fecal bacteria loads for the Linville Creek watershed (drainage basin) needed to restore it so that it would meet water quality standards for fecal bacteria and fully support primary contact recreation. It also established the reductions in sediment that were necessary for the benthic macroinvertebrate community to achieve a not impaired rating (Virginia Stream Condition Index score > 60) and compliance with the general water quality standard.

Virginia law requires that an implementation plan be developed to show how fully supporting status for impaired waters can be achieved and the pollutant load reductions established in the TMDL studies can thereby be met. In fulfilling the state's requirement for the development of a TMDL Implementation Plan (IP), a framework was established for reducing fecal bacteria and sediment levels to achieve the water quality goals for the impaired streams.

Review of TMDL Development

Biological Systems Engineering from Virginia Tech developed fecal bacteria and sediment TMDLs for Linville Creek (USEPA approval on September 22, 2003).

Modeling conducted in support of the fecal bacteria TMDL considered loads in runoff resulting from wildlife (e.g., deer, raccoon, muskrat, beaver, turkey, goose, mallard, and wood duck), livestock (e.g., beef, dairy and horse), residential (e.g., failing septic systems, straight pipes, dogs and cats) sources. Direct loads to the stream (including direct deposition from cattle and wildlife), uncontrolled discharges (failing septic systems and straight pipes), and permitted sources were also modeled. The *E. coli* standards current at the time of modeling, along with an implicit Margin of Safety (MOS) were used as the water quality endpoints.

Modeling conducted in support of the sediment TMDL considered surface runoff, channel erosion, streambank damage from livestock, point source inputs and other forms of human based land disturbance.

The Linville Creek watershed TMDLs show that in order to meet the water quality standard for fecal bacteria and sediment the following reductions shown in Table ES. 1 and Table ES. 2 must be achieved in the listed watersheds.

Table ES. 1 Fecal bacteria TMDL reductions for the Linville Creek Watershed.

Wildlife Direct	Livestock Direct	Agricultural Land Based	Human Direct	Residential	Loafing Lot
95%	**100%**	**96%**	100%	**99%**	**100%**

Table ES. 2 Sediment TMDL reductions for the Linville Creek Watershed.

Agriculture	Residential	Channel Erosion
9.6%	0%	24.6%

Public Participation

The actions and commitments described in this document were drawn together through input from local citizens, local government representatives, Virginia Departments of Conservation and Recreation (VADCR), Environmental Quality (VADEQ), and Health (VDH), Virginia Cooperative Extension (VCE), Natural Resources Conservation Service

(NRCS), the Shenandoah Valley Soil and Water Conservation District (SVSWCD), MapTech, Inc and other organizations. Every citizen and interested party in the watershed is encouraged to become involved in implementing the plan to help restore the health of the Linville Creek watershed.

Public meetings were conducted to distribute information and gain feedback from the community. Active participation was solicited in smaller forums called working groups. These groups were comprised of stakeholders with similar concerns (*e.g.*, agricultural and residential/urban/governmental). Representatives from each working group participated in the Steering Committee, where input from the working groups was reviewed and decisions about the IP were made. Throughout the public participation process, a major emphasis was placed on discussing best management practices (BMPs), BMP specifications, locations of control measures, education, technical assistance, and funding.

Opinions were voiced throughout the public participation meetings regarding what should be included in the Implementation Plan. Most members of the working groups agreed that the cornerstone of the Implementation Plan should be cultivating public involvement and education, and encouraging commitment and partnerships between the citizens in the watershed and government agencies in order to reduce fecal bacteria pollution in Linville Creek watershed.

Assessment of Implementation Action Needs

A series of implementation actions for urban, residential and agricultural land uses was compiled for this plan including BMPs and related education and outreach strategies. Input was collected from the community regarding the most appropriate actions for the Linville Creek watershed. This input was used to develop and refine a 3-stage implementation scenario over an 18-year implementation period to improve water quality in Linville Creek. It is expected that this scenario will change as implementation efforts progress and more is learned about landowner needs with respect to BMPs and land use management. However, this scenario represents a good starting point for restoring water quality in Linville Creek.

Recommended residential septic implementation actions include:

- 131 repairs of failing septic systems
- 67 failing septic system replacements with conventional treatments systems
- 131 failing septic system replacements with alternative waste treatment systems
- 7 replacements of failing septic systems with connection to public sewer
- 300 septic tank pump-outs

Recommended urban/residential stormwater implementation actions include:

- 5 bioretention filters
- 8 rain gardens
- 15 acres of riparian buffers

Recommended pet waste implementation actions include:

- 4 neighborhood pet waste stations
- 49 residential pet waste composters
- 5 commercial pet waste composters (boarding facilities etc.)
- Implementation of a pet waste education program

Recommended agricultural implementation actions include:

- 50 miles of livestock exclusion fencing (138 systems)
- 9,150 acres improved pasture management
- 14 loafing lot management systems
- 584 acres permanent vegetative cover on critical pasture areas
- 584 acres reforestation of erodible pasture
- 11 Manure storage facilities (beef)
- 4 Manure storage facilities (non-permitted poultry)
- 100 pasture acres treated with sediment control structures
- 188 acres permanent vegetative cover on cropland
- 2,407 acres continuous no till
- 1,584 acres cover crops
- 5 acres forested riparian buffers on cropland
- 46 acres of riparian grass filter strips on cropland

Recommended streambank erosion implementation actions include:

- 3,000 feet of streambank stabilization on agricultural and residential/urban land

Cost/Benefit Analysis

The costs of the above control measures were determined based on the cost of control measures previously installed through the Virginia Cost-Share Program in the Linville Creek watershed, and discussions with local agency representatives and working groups. The cost of technical assistance needed to implement the control measures was

determined based upon discussions with working group members and technical assistance costs from both ongoing and previous Implementation Plans in similar watersheds. The estimated total cost to install agricultural and residential control measures in the Linville Creek watershed is $13,001,022 excluding technical assistance. The estimated total cost to provide technical assistance during implementation for the Linville Creek watershed is expected to be $1,400,000. The total cost estimated for eighteen years of implementation in the Linville Creek watershed is $14,401,022.

The primary benefit of implementation is the reduction of *E. coli* bacteria and sediment in this watershed. With the completion of this Implementation Plan, the risk of illness or infection as a result of direct contact with *E. coli* bacteria through swimming in or drinking water from this stream will decrease significantly. Streambank protection, provided through exclusion of livestock from streams, will also lead to improved aquatic habitat. The practices recommended in this document will provide economic benefits to landowners in addition to the anticipated environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, and intensive pasture management will improve profitability of farms, while private sewage system installation and maintenance will ultimately save homeowners money by preventing expensive fees and repairs. Keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (1998a) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7 billion to 2 billion annually or 11% of total U.S. milk production. While the spread of mastitis through a dairy herd can be reduced through proper sanitation of milking equipment, mastitis-causing bacteria can be harbored and spread in the environment where cattle have access to wet and dirty areas.

Measurable Goals and Milestones for Attaining Water Quality Standards

Potential funding sources available during implementation were identified during plan development. Sources may include, but are not limited to:

- Federal Clean Water Act Section 319 Incremental Funds
- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Tax Credit Program

- USDA Environmental Quality Incentives Program (EQIP)
- Virginia Revolving Loan Programs (Agricultural BMPs and onsite sewage disposal systems)
- USDA Wildlife Habitat Incentive Program (WHIP)
- Virginia Water Quality Improvement Fund

Implementation is scheduled to occur in two main stages. The first stage (Stage I) lasting seven years involves implementation of the most cost-effective control measures. The measures included in this stage are expected to significantly reduce the level of *E. coli* in these streams, and remove the sediment impairment from the State's impaired waters list. Stage II lasting seven years, involves installing control measures to reduce *E. coli*. During Stage III lasting four years, the remaining available control measures will be installed.

It is estimated that the scheduled practices will result in meeting the TMDL sediment reduction goal by the end of Stage 1. However, the reductions proposed through Stage III for non-wildlife sources will not improve water quality sufficiently to meet the bacteria standard. To demonstrate the impact of wildlife loads on the bacteria impairment, the TMDL model was loaded with all reductions through the Stage III and a 95% reduction to wildlife. The result was an estimated single sample bacteria violation rate of 11%. In other words, significant load reductions from all sources including wildlife would be required in order to approach delisting of the impairments (achieve less than a 10.5% violation rate of the bacteria standard). The need to also address wildlife sources makes it highly unlikely that the non-wildlife implementation practices alone will produce water quality that meets the bacteria standard. Nevertheless, the practices employed over the three stages make a significant improvement in water quality.

Identification of critical areas to be targeted first for agricultural BMP installation was accomplished through analysis of land use, farm boundaries, stream network Geographic Information Systems (GIS) layers, and monitoring results. The subwatersheds were ranked by the ratio of animals per length of fence needed and by the combined failing septic systems and straight pipes loads estimated in each subwatershed.

Stakeholders and Their Role in Implementation

Implementation progress success will be determined by water quality monitoring conducted by VADEQ through the agency's monitoring program.

The SVSWCD will be in charge of initiating contact with farmers in the impaired watershed to encourage the installation of agricultural BMPs. Friends of the North Fork of the Shenandoah River have expressed interest in administering a septic maintenance cost-share program if funds are available. This one-on-one contact will facilitate communication of the water quality problems and the corrective actions needed. The SVSWCD staff will conduct outreach activities in the watersheds to garner the participation and community support necessary to obtain implementation milestones, and to make the community aware of the water quality impairments present in the Linville Creek watershed and how they may affect local residents. Such activities will include information exchange through newsletters, mailings, field days, organizational meetings, and so on. The SVSWCD staff will work with appropriate organizations (such as VCE) to educate the public.

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. The agencies regulating activities that impact water quality in Virginia include: VADEQ, VADCR, Virginia Department of Agriculture and Consumer Services (VDACS), DMME and VDH.

Achieving the goals of this IP (*i.e.*, improving water quality and removing these waters from the Section 303(d) list) is dependent on stakeholder participation – not only the local citizens needing agricultural control measures or residential waste treatment facilities, but also all citizens living in the watershed. It must be acknowledged first that there is a water quality problem, and changes must be made as needed in operations, programs, and legislation to address these pollutants. Local citizens can become involved by picking up after their pets, properly maintaining their septic systems, becoming water quality monitoring volunteers and volunteering to distribute information and educate others at public events.

page intentionally blank

1. INTRODUCTION

1.1 Background

The detrimental effects of bacteria in food and water supplies have been documented repeatedly. On August 8, 1994, the Virginia Department of Health (VDH) was notified that campers and counselors at a Shenandoah Valley summer camp developed severe gastrointestinal illness. It was confirmed that *E. coli* 0157:H7, a type of fecal coliform bacteria commonly found in the intestines of humans and animals, was the causative agent (CDC, 1995).

In Franklin County, Virginia, a 1997 outbreak of illnesses involving three children was attributed to *E. coli* (0157:H7) in Smith Mountain Lake. The children came in contact with the bacteria while swimming in the lake and a two-year-old child almost died as a result of the exposure (Roanoke Times, 1997a, 1997b, 1998b).

In August 1998, seven children and two adults at a day-care center in rural Floyd County were infected with *E. coli* (0157:H7). Upon investigation, two of the property's wells tested positive for total coliform (Roanoke Times, 1998a, 1998c). On June 6, 2000, Crystal Spring, (Roanoke, Virginia's second largest water source) was shut down by the VDH for *E. coli* contamination (Roanoke Times, 2000).

These are not isolated cases. Throughout the United States, the Centers for Disease Control estimates that at least 73,000 cases of illnesses and 61 deaths per year are caused by *E. coli* 0157:H7 bacteria (CDC, 2001). Other fecal coliform (FC) pathogens (*e.g., E. coli* 0111) are responsible for similar illnesses. In addition, the presence of other bacterial and viral pathogens is indicated by the presence of FC. Whether the source of contamination is human or livestock waste, the threat of these pathogens appears more prevalent as both populations increase. As stakeholders, we must assess the risk we are willing to accept and then implement measures to safeguard the public from these risks.

The Clean Water Act (CWA) that became law in 1972 requires that all U.S. streams, rivers, and lakes meet their state's water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards.

Through this required program, the state of Virginia has found that many stream segments do not meet state water quality standards for protection of the six beneficial uses: recreation/swimming, aquatic life, wildlife, fish consumption, shellfish consumption, and public water supply (drinking).

When streams fail to meet standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130) both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed and approved by the State Water Control Board (SWCB) and EPA, measures must be taken to reduce pollution levels in the stream. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters". The TMDL Implementation Plan (IP) describes control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), to be implemented in a staged process.

Table 1.1 contains descriptive information for the Linville Creek impairments. Linville Creek is located in Rockingham County, Virginia (**Figure 1.1**). It was originally listed in 1998 as impaired from its headwaters to its confluence with the North Fork Shenandoah River, 13.49 miles downstream. It was listed for not supporting the recreation/swimming and aquatic life (benthic macroinvertebrate impairment) use.

Table 1.1 Descriptive information for fecal bacteria and benthic macroinvertebrate impairments in the Linville Creek Watershed.

Stream Name Impairment ID	Impairment Type	Impairment Location Description	Initial Listing Year	River Miles
Linville Creek VAV-B34_LNV01A00	Bacteria & Benthic Macroinvertebrates	From the headwaters downstream to its confluence with the North Fork Shenandoah River.	1998	13.49

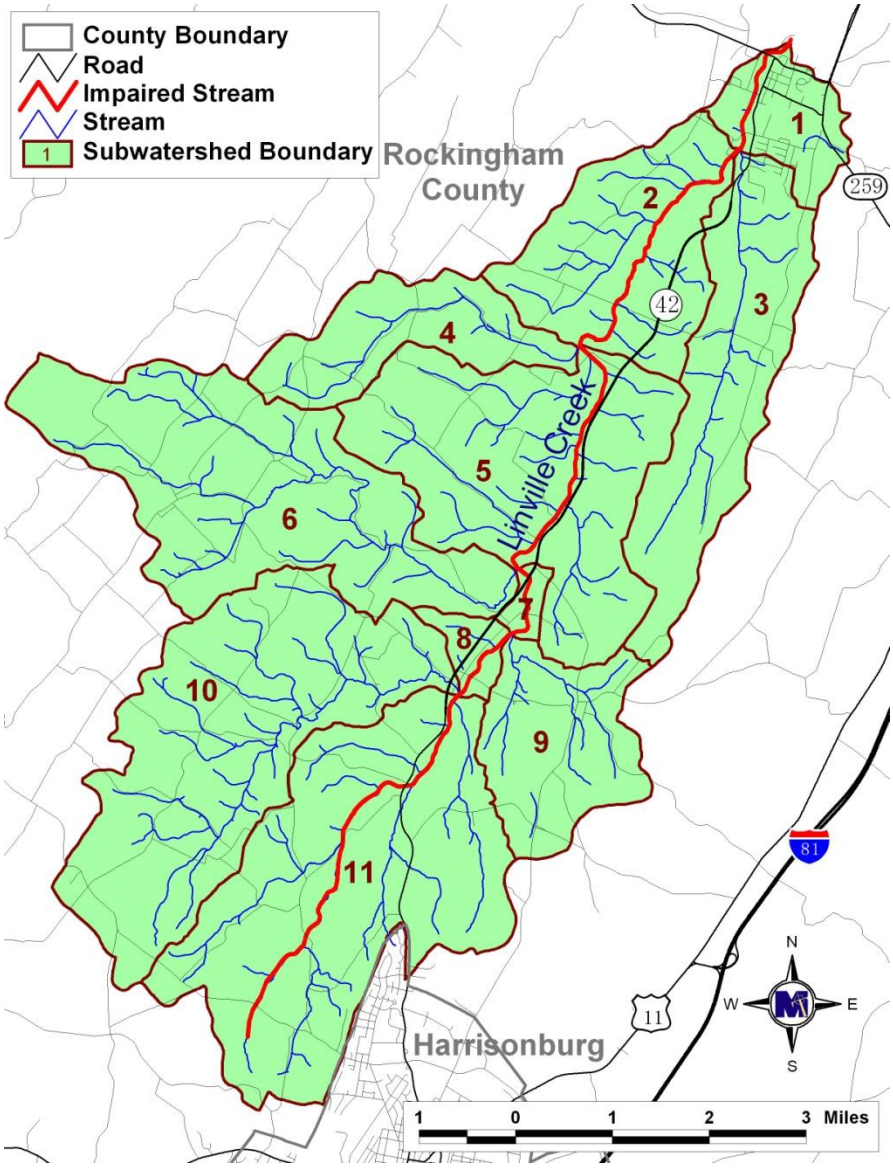


Figure 1.1 Location of impaired segments in the Linville Creek Watershed.

Land use information for the Linville Creek watershed is shown in **Table 1.2** and **Figure 1.2**. The TMDL classification was based on the Multi-Resolution Land Characterization Consortium (MRLC) 2000 dataset from multi-spectral Landsat imagery. This was subset into nonstandard categories for the TMDL. The current landuse categories (MRLC06) are tabled below along with the TMDL categories.

Table 1.2 Spatial distribution of land use for the Linville Creek Watershed: TMDL and MRLC06.

TMDL Landuse	Acres	MRLC06 Landuse Categories	Category Acres
Cropland	6,335	Cropland	6,335
Pasture 1	8,196	Pasture	14,796
Pasture 2	1,794		
Pasture 3	4,642		
Loafing	164		
Farmstead	1,194	Developed	3,846
Rural Residential	1,835		
Urban Residential	817		
Forest	4,668	Forest	4,668
		Water	0
		Wetland	0
Total	**29,645**		

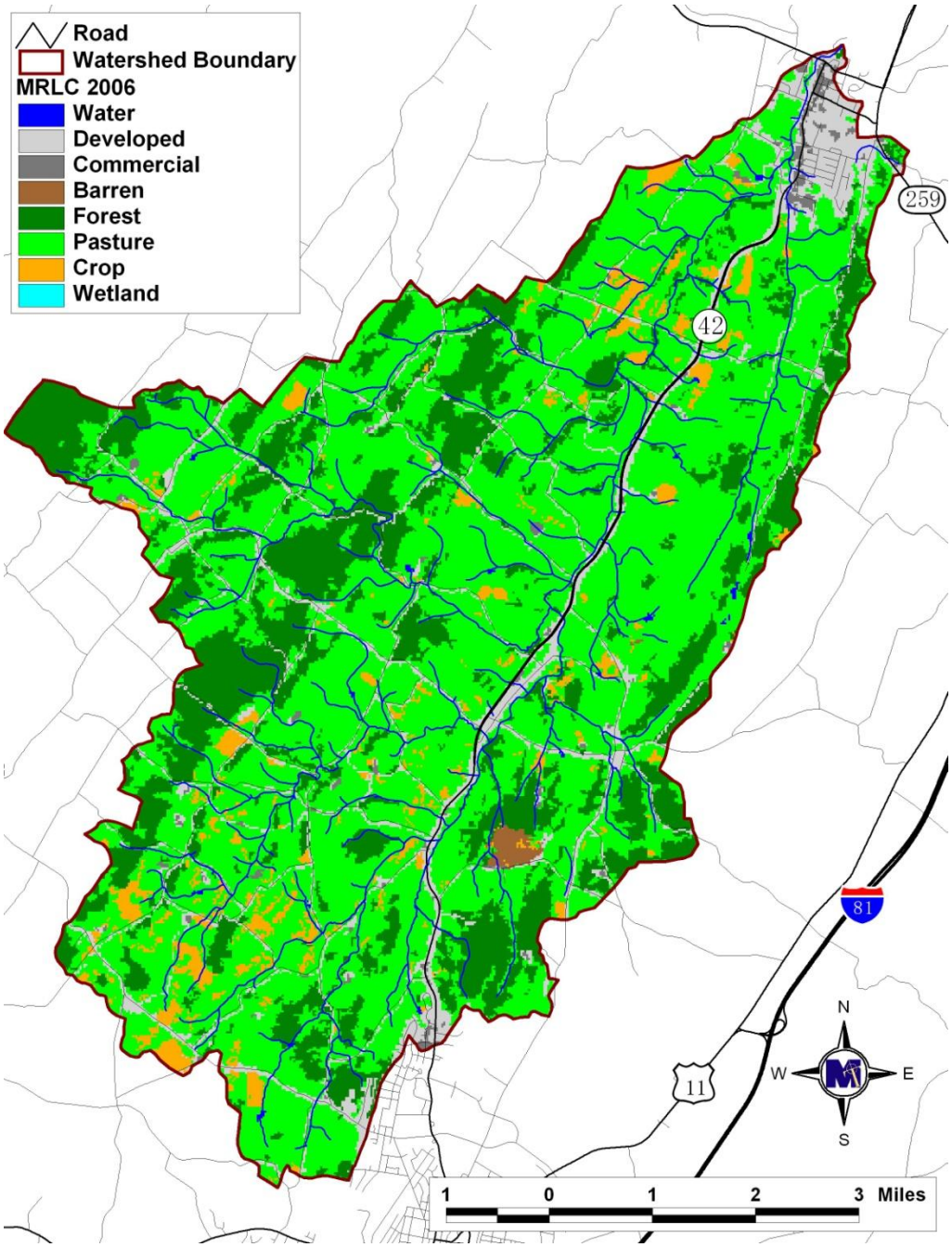


Figure 1.2 Land uses in the Linville Creek Watershed.

In developing this IP, elements from both state and federal guidance were incorporated and the recommended guidelines from Virginia's *Guidance Manual for Total Maximum Daily*

Load Implementation Plans were followed. Specific state and federal requirements of an IP are described in Chapter 2 of this document.

Once developed, the Virginia Department of Environmental Quality (VADEQ) will take TMDL Implementation Plans to the SWCB for approval as the plan for implementing the pollutant allocations and reductions contained in the TMDLs. Also, VADEQ will request SWCB authorization to incorporate the TMDL Implementation Plan into the appropriate Water Quality Management Plan (WQMP) in accordance with the CWA's Section 303(e). In response to a Memorandum of Understanding (MOU) between EPA and VADEQ, VADEQ also submits a draft Continuous Planning Process to EPA in which VADEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL Implementation Plans developed within a river basin.

1.2 Applicable Water Quality Standards

According to Virginia Water Quality Standard 9 VAC 25-260-5, the term 'water quality standards' means "provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law and the federal Clean Water Act."

Virginia Water Quality Standard 9 VAC 25-260-10 (Designation of uses) states:

A. All state waters, including wetlands, are designated for the following uses: recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.

◆

E. At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under §§ 301(b)(1)(A) and (B) and 306 of the Clean Water Act and cost-effective and reasonable best management practices for nonpoint source control.

◆

H. The [State Water Quality Control] Board may remove a designated use which is not an existing use, or establish subcategories of a use, if the board can demonstrate that attaining the designated use is not feasible because:

1. *Naturally occurring pollutant concentrations prevent the attainment of the use;*

2. *Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating state water conservation requirements to enable uses to be met;*

3. *Human caused conditions or sources of pollution prevent the attainment of the use and cannot be remedied or would cause more environmental damage to correct than to leave in place;*

4. *Dams, diversions or other types of hydrologic modifications preclude the attainment of the use, and it is not feasible to restore the water body to its original condition or to operate such modification in a way that would result in the attainment of the use;*

5. *Physical conditions related to the natural features of the water body, such as the lack of a proper substrate, cover, flow, depth, pools, riffles, and the like, unrelated to water quality, preclude attainment of aquatic life protection uses; or*

6. *Controls more stringent than those required by §§ 301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.*

I. The board may not remove designated uses if:

1. *They are existing uses, unless a use requiring more stringent criteria is added; or*

2. *Such uses will be attained by implementing effluent limits required under §§ 301(b)(1)(A) and (B) and 306 of the Clean Water Act and by implementing cost-effective and reasonable best management practices for nonpoint source control.*

At the time stream segments in the Linville Creek watershed were first designated as impaired, TMDLs were developed for fecal coliform bacteria based on the fecal coliform State water quality criterion. Although the impairment was based on fecal coliform, the Linville Creek bacteria TMDL was developed for the 2003 *E. coli* standard. Virginia's current bacterial standard uses *E. coli* and *enterococci* as bacterial indicators. *E. coli* and

enterococci are both bacteriological organisms that can be found in the intestinal tract of warm-blooded animals; there is a strong correlation between these and the incidence of gastrointestinal illness. Like fecal coliform bacteria, these organisms indicate the presence of fecal contamination. Prior to January 2003, Virginia's water quality standard in fresh water for swimming/recreational use was based on fecal coliform rather than *E.coli.* The change was based on EPA's recommendation that all states adopt an *E. coli* or *enterococci* standard for fresh water and *enterococci* criteria for marine waters by 2003. The EPA pursued the states' adoption of these standards because there is a stronger correlation between the concentration of these organisms (*E. coli* and *enterococci*) and the incidence of gastrointestinal illness than with fecal coliform.

Virginia's current criteria are outlined in Section 9 VAC 25-260-170 and read as follows:

A. The following bacteria criteria (colony forming units (CFU)/100 ml) shall apply to protect primary contact recreational uses in surface waters, except waters identified in subsection B of this section:

E.coli bacteria shall not exceed a monthly geometric mean of 126 CFU/100 ml in freshwater.

Enterococci bacteria shall not exceed a monthly geometric mean of 35 CFU/100 ml in transition and saltwater.

1. *See 9VAC25-260-140 C for boundary delineations for freshwater, transition and saltwater.*

2. *Geometric means shall be calculated using all data collected during any calendar month with a minimum of four weekly samples.*

3. *If there are insufficient data to calculate monthly geometric means in freshwater, no more than 10% of the total samples in the assessment period shall exceed 235 E.coli CFU/100 ml .*

4. *If there are insufficient data to calculate monthly geometric means in transition and saltwater, no more than 10% of the total samples in the assessment period shall exceed enterococci 104 CFU/100 ml.*

5. *For beach advisories or closures, a single sample maximum of 235 E.coli CFU/100 ml in freshwater and a single sample maximum of 104 enterococci CFU/100 ml in saltwater and transition zones shall apply.*

If the waterbody exceeded either criterion more than 10.5% of the time, the waterbody was classified as impaired and a TMDL was developed and implemented to bring the waterbody into compliance with the water quality criterion. Based on the sampling frequency, only one criterion was applied to a particular datum or data set (Virginia Water Quality Standard 9 VAC 25-260-170). If the sampling frequency was one sample or less per 30 days, the instantaneous criterion was applied; for a higher sampling frequency, the geometric criterion was applied.

Most of the VADEQ's ambient water quality monitoring is done on a monthly or bi-monthly basis. This sampling frequency does not provide the two or more samples within 30 days needed for use of the geometric mean part of the standard

In addition Linville Creek is in violation of the general standard for aquatic life use. The General Standard, as defined in Virginia state law 9 VAC 25-260-20, states:

A. All state waters, including wetlands, shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established standards or interfere directly or indirectly with designated uses of such water or which are inimical or harmful to human, animal, plant, or aquatic life.

Prior to 2008, this General Criteria was assessed in terms of its impact on aquatic life by VADEQ through application of the modified Rapid Bioassessment Protocol II (RBP II) (Barbour, 1999). However, in January 2008 VADEQ moved to a multimetric index approach called the Virginia Stream Condition Index (VASCI) (Burton, 2003). The health of the benthic macroinvertebrate community is assessed through measurement of eight biometrics statistically derived from numerous reference sites in the non-coastal regions of Virginia. Surveys of the benthic macroinvertebrate community performed by VADEQ are assessed at the family taxonomic level. VADEQ's "non-impaired" benchmark with the VASCI is a total score of 60 (10^{th} percentile of the reference sites).

1.3 Water Quality Standard Changes

Two regulatory actions related to the bacteria water quality standard in Virginia have been implemented. The first rulemaking pertains to the indicator species used to measure bacteria

pollution. The second rulemaking is an evaluation of the designated uses as part of the state's triennial review of its water quality standards.

1.3.1 Indicator Species

The EPA recommended that all states adopt an *E. coli* or *enterococci* standard for fresh water and *enterococci* criteria for marine waters by 2003. The EPA pursued the states' adoption of these standards because there is a stronger correlation between the concentration of these organisms (*E. coli* and *enterococci*) and the incidence of gastrointestinal illness than with fecal coliform. *E. coli* and *enterococci* are both bacteriological organisms that can be found in the intestinal tract of warm-blooded animals. Like fecal coliform bacteria, these organisms indicate the presence of fecal contamination. The transition to the *E. coli* and *enterococci* standard began in 2003 and was completed in June 2008. For the 2006, 2008 and 2010 305(b)/303(d) Water Quality Assessment Integrated Report the new standard was used to assess the bacteria data. The *E. coli* water quality standard has an instantaneous level of 235 colony-forming units (cfu) per 100 ml and geometric mean of 126 colony-forming units (cfu) per 100 ml for two or more samples over a 30-day period.

1.4 Site-Specific Criteria and Designated Use Changes

In some cases site-specific criteria or designated use changes for the impaired waters may be pursued, based on the actual use of the water body or the level of wildlife contribution. In these cases, the completion of a Use Attainability Analysis (UAA) is required. A UAA is a structured scientific assessment of the factors affecting the attainment of the use, which may include physical, chemical, biological, and economic factors as described in the Federal Regulations. All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. The stakeholders in the watershed, Virginia, and EPA will have an opportunity to comment on these studies and any proposed changes.

1.4.1 Actual Use of the Water Body

All waters in the Commonwealth have been designated as "primary contact" for the swimming use regardless of size, depth, location, water quality or actual use. The bacteria standard is described in 9 VAC 25-260-170 and in **Section 1.2** of this report. This standard

is to be met during all stream flow levels and was established to protect bathers from ingestion of potentially harmful bacteria. However, many headwater streams are small and shallow during base flow conditions when surface runoff has minimal influence on stream flow. Even in pools, these shallow streams do not allow full body immersion during periods of base flow. In larger streams, lack of public access often precludes the swimming use.

Recognizing that all waters in the Commonwealth are not used extensively for swimming, Virginia has approved a process for re-designation of the recreational use for secondary contact in cases of: 1) natural contamination by wildlife, 2) small stream size, and 3) lack of accessibility to children, as well as due to widespread socio-economic impacts resulting from the cost of improving a stream to a "swimmable" status. The re-designation of the current recreational use in a stream would require the completion of a UAA as described above.

1.4.2 Wildlife Contributions

In some streams for which TMDLs have been developed, water quality modeling indicates that even after removal of all of the sources of bacteria (other than wildlife), the stream will not attain standards. TMDL allocation reductions of this magnitude are not realistic and do not meet EPA's guidance for reasonable assurance. Based on the water quality modeling, many streams will not be able to attain standards without some reduction in wildlife. Virginia and EPA are not proposing the reduction of wildlife to allow for the attainment of water quality standards. This is obviously an impractical action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL. In such a case, after demonstrating that the source of bacterial contamination is natural and uncontrollable by effluent limitations and BMPs, the state may decide to re-designate the stream's use for secondary contact recreation or to adopt site-specific criteria based on natural background levels of bacteria. The state must demonstrate that the source of bacterial contamination is natural and uncontrollable by effluent limitations and BMPs through a UAA as described above.

1.5 Project Methodology

The overall goal of this project was to begin the process of restoring water quality in the Linville Creek watershed impaired stream segment.

The key components of the staged Implementation Plan are discussed in detail in the following sections: State and Federal Requirements for Implementation Plans, Review of TMDL Development, Process for Public Participation, Assessment of Needs, Measurable Goals and Milestones, and Implementation.

In fulfilling the state's requirement for the development of a TMDL IP, a framework has been established for reducing *E. coli* and sediment levels and achieving the water quality goals for the Linville Creek watershed impaired segment for which TMDL allocations were developed. With successful completion of the IP, Virginia will be well on the way to restoring the impaired waters and enhancing the value of this important resource. Additionally, development of an approved IP will improve the localities' chances for obtaining monetary assistance during implementation.

2. STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

There are a number of state and federal requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define what they are and explicitly state if the "elements" are a required component of an approvable IP or are merely a recommended topic that should be covered in a thorough IP. This chapter has three sections that discuss a) the requirements outlined by the WQMIRA that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, b) the EPA recommended elements of IPs, and c) the required components of an IP in accordance with Section 319 guidance.

2.1 State Requirements

The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs the SWCB to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for IPs to be approved by the Commonwealth, they must meet the requirements as outlined by WQMIRA. WQMIRA requires that IPs include the following:

- date of expected achievement of water quality objectives,
- measurable goals,
- necessary corrective actions, and
- associated costs, benefits, and environmental impact of addressing the impairment.

2.2 Federal Recommendations

Section 303(d) of the CWA and current EPA regulations do not require the development of implementation strategies. The EPA does, however, outline the minimum elements of an approvable IP in its 1999 *Guidance for Water Quality-Based Decisions: The TMDL Process.*

The listed elements include:

- description of the implementation actions and management measures,
- time line for implementing these measures,
- legal or regulatory controls,
- the time required to attain water quality standards, and
- monitoring plan and milestones for attaining water quality standards.

It is strongly suggested that the EPA recommendations be addressed in the IP, in addition to the required components as described by WQMIRA.

2.3 Requirements for Section 319 Fund Eligibility

The EPA develops guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;
3. Describe the NPS management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan;
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

3. REVIEW OF TMDL DEVELOPMENT

Biological Systems Engineering from Virginia Tech was contracted to develop *E. coli* bacteria and sediment TMDLs for the Linville Creek watershed. The TMDLs were completed in March 2003 and approved by the USEPA on September 22, 2003. The TMDL document is posted at the Virginia Department of Environmental Quality website, www.deq.virginia.gov. The *E. coli* and sediment load reductions called for in the TMDL studies were reviewed to determine the water quality goals and associated pollutant reductions that would need to be addressed through the development of the Implementation Plan.

3.1 Water Quality Modeling

In order to understand the implications of the load allocations determined during TMDL development, it is important to understand the modeling methods used in the analysis.

3.1.1 Fecal Bacteria Modeling

The USGS Hydrologic Simulation Program - Fortran (HSPF) water quality model was used as the modeling framework to simulate hydrology and fecal coliform fate and transport for the bacteria TMDL allocations. The water quality endpoint used for determining the necessary reduction to *E. coli* loads was the 30-day geometric mean standard (126 cfu/100 mL) and the instantaneous standard (235 cfu/100 mL), with an implicit margin of safety.

Potential sources of *E. coli* and sediment considered in the TMDL development included both point source and nonpoint source contributions. Permitted point sources that discharge fecal bacteria are shown in **Table 3.1**.

Table 3.1 Permitted point sources in Linville Creek watershed.

Permit #	Facility Name	Design Flow (MGD)	Permitted for Fecal Bacteria
VA0085588	Virginia Department of Corrections – Field Unit #8	0.03	Yes
VA0079898	Town of Broadway – Water Treatment Plant	0.07	No

Notes: MGD; million gallons per day

Permitted point discharges that may contain pathogens associated with fecal matter are required to maintain Fecal Coliform concentrations below 126 cfu/100 mL. One method for achieving this goal is chlorination. Chlorine is added to the discharge stream at levels intended to kill any pathogens. The monitoring method for ensuring the goal is to measure the concentration of total residual chlorine (TRC) in the effluent. If the concentration is high enough, pathogen concentrations, including *E. coli* concentrations, are considered reduced to acceptable levels. Typically, if minimum TRC levels are met, bacteria concentrations are reduced to levels well below the 126 cfu/100 mL limit.

Both urban and rural nonpoint sources of *E. coli* bacteria were considered in water quality modeling. Sources included residential sewage treatment systems, land application of waste, livestock, wildlife, and domestic pets. Loads were represented either as land-based loads (where they were deposited on land and available for wash off during a rainfall event) or as direct loads (where they were directly deposited to the stream). Land-based nonpoint sources are represented as an accumulation of pollutants on land, where some portion is available for transport in runoff. The amount of accumulation and availability for transport vary with land use type and season. The model allows a maximum accumulation to be specified. The maximum accumulation was adjusted seasonally to account for changes in die-off rates, which are dependent on temperature and moisture conditions. Some nonpoint sources, rather than being land-based, are represented as being deposited directly to the stream (*e.g.,* animal defecation in the stream, straight pipes). These sources are modeled similar to point sources, as they do not require a runoff event for delivery to the stream.

3.1.2 *E. coli* Model Allocations

Several model runs were made investigating scenarios that would meet the 30-day geometric mean and instantaneous TMDL goal of 126 and 235 cfu/100mL, respectively (includes an implicit margin of safety). The final load allocations are shown in **Table 3.2**.

The final allocation scenarios call for a 100% reduction of human straight pipes (failed septic systems are also considered to have a 100% reduction because they are illegal), 100% reduction from direct in-stream loading and loafing lot contributions from livestock, a 96%

reduction of the *E. coli* loading from agricultural land, a 99% reduction of the *E. coli* loading from residential land uses, and a 95% reduction from wildlife direct deposit sources.

Table 3.2 Fecal bacteria load reductions allocated during TMDL development for the Linville Creek Watershed.

Impairment	Loafing Lot	Livestock Direct Deposit	Cropland & Pasture Land Based	Human Direct Deposit (Straight Pipes	Residential Land Based	Wildlife Direct Deposit
Linville Creek	100%	100%	96%	100%	99%	95%

3.1.3 Sediment Model Allocations

Excessive sedimentation is considered to be one of the primary causes of the benthic macroinvertebrate impairment in Linville Creek. Linville Creek received repeated low habitat scores for bank stability, substrate availability, bank vegetation, riparian vegetation, and embeddedness. Additionally, there was observed trampling and damage to stream banks from livestock having access to the creek. Taken together, these observations support the case for sediment being the most likely stressor on the benthic community.

The Generalized Watershed Loading Function (GWLF) model (Haith et al., 1992) was used to model sediment for Linville Creek. Since there is no state standard for sediment, a reference watershed approach was used to establish the water quality endpoint for TMDL allocations. Using this approach, a similar, but non-impaired, watershed is selected and modeled to determine the acceptable load of the pollutant in question. The reference watershed for the Linville Creek watershed was the Upper Opequon Creek in Frederick County. The final allocated sediment loads are shown in (**Table 3.3**).

Table 3.3 Sediment load reductions allocated during TMDL development for the Linville Creek watershed.

Sediment Source	Existing Sediment Load (t/yr)	TMDL Sediment Load (t/yr)	Required Reduction
Agricultural	28,904	26,126	9.6%
Urban	132	132	0.0%
Stream Channel Erosion	6,407	4,831	24.6%
Point Source	1.4	5.3	0.0%
Total			12.3%

Note: t/yr .. tons per year

3.2 Implications of TMDL and Modeling Procedure on Implementation Plan Development

The major implication in the development of these TMDLs is that large reductions are required to achieve the water quality standard. All uncontrolled discharges, failing septic systems, leaking sewer lines, and overflows must be identified and corrected; livestock must be excluded from streams and most of the residential nonpoint sources must be reduced. Additionally, substantial reductions in bacteria from wildlife would be necessary in order to meet the TMDL for *E. coli*.

However, there are subtler implications as well. Implicit in the requirement for 100% correction of uncontrolled discharges is the need to maintain all functional septic systems.

These TMDLs included straight pipes and failing septic systems in the total bacteria load to the streams. The number of straight pipes (5) and failing septic systems (330) were estimated. In instances where currently available data was different than data in the TMDL report, the best available data was used to quantify corrective actions and develop cost estimates.

4. PUBLIC PARTICIPATION

Public participation was an integral part of the TMDL Implementation Plan development, and is critical to promote reasonable assurances that the implementation activities will occur. Attendance was encouraged through email, phone calls and notices sent to the local newspaper.

4.1 Public Meetings for the Linville Creek Watershed

Two public meetings were held for the project. The first public meeting was held at the Linville Edom Ruritan Hall in Linville, Virginia on November 27, 2012. The meeting was publicized by flyers and neighborhood postings and was attended by seventy-two (72) people, including, citizens and members of government. Information delivered to the public at the meeting included a general description of the TMDL process, a more detailed description of TMDL development and IP development, and a solicitation for participation in working groups.

The final public meeting for Linville Creek watershed was held on August 13, 2013 in the Linville Edom Ruritan Hall in Linville, VA. The primary purpose of this meeting was to present the final TMDL Implementation Plan. A presentation was given describing the Implementation Plan using major components as an outline: review of TMDL development, public participation, assessment of needs, cost/benefit analysis, and implementation.

In addition to the public meetings, a steering committee and two specialized working groups (agricultural and residential/urban) were assembled from communities of people with common concerns regarding the TMDL process. The working groups served as the primary arena for seeking public input on implementation actions to be included in the plan, associated costs and outreach methods. The steering committee reviewed reports from each of the working groups and helped to guide the overall development of the Implementation Plan. A representative of the Virginia Department of Conservation and Recreation (VADCR) attended each working group and steering committee meeting in order to facilitate the process and integrate information collected from the various communities. The minutes from each of the working groups and the steering committee are included in Appendix A.

The role of the Agricultural and Residential/Urban Working Group was to review implementation from an agricultural perspective, identify any obstacles (and solutions) related to BMP implementation, and to provide estimates on the type, number, and costs of BMPs by implementation stage. Streamside fencing in the Linville Creek main stem was presented as a problem. The residential/urban group discussed methods needed to reduce human and pet sources of bacteria entering Linville Creek watershed, recommended methods to identify and correct or replace failing septic systems and straight pipes, and provided input on the BMPs to include in the plan.

All meetings conducted during the course of the TMDL IP development are listed in **Table 4.1**. Individuals on local and state levels representing agricultural and residential/governmental interests devoted many work-hours to attending meetings.

Table 4.1 Meetings held pertaining to the Linville Creek Watershed TMDL Implementation Plan development.

Date	Meeting Type	Location	Attendance
October 3, 2012	Informational	Shenandoah Valley NRCS Office, Harrisonburg, VA	6
November 27, 2012	Public	Linville Edom Ruritan Hall, Linville, VA	72
November 27, 2012	Agricultural WG	Linville Edom Ruritan Hall, Linville, VA	60
November 27, 2012	Residential WG	Linville Edom Ruritan Hall, Linville, VA	12
January 20, 2013	Agricultural WG	Linville Edom Ruritan Hall, Linville, VA	14
February 5, 2013	Residential WG	J. Frank Hilyard Elementary School, Broadway, VA	5
April 16, 2013	Steering Committee	Linville Edom Ruritan Hall, Linville, VA	14
August 13, 2013	Final Public	Linville Edom Ruritan Hall, Linville, VA	TBD

Note: WG .. Working Group

4.1.1 Agricultural Working Group

The first meeting of the Agricultural Working Group met November 27, 2013 at the Linville Edom Ruritan Hall in Linville, Virginia. The 60 attendants consisted of citizens, members of the farming community, representatives from Shenandoah Valley Soil and Water Conservation District, VADEQ, VDH, VADCR, and MapTech, Inc. Discussion focused on the current status of agriculture in the watershed, stream fencing and riparian buffer practices

(e.g., LE-1T and WP-2T) for which financial assistance (cost share) is available through the State Cost Share Program, and the maintenance issues involved with these practices.

The second meeting took place on January 20, 2013 at the Linville Edom Ruritan Hall in Linville, Virginia. Fourteen (14) members were in attendance. The group discussed the fencing estimates that had been prepared for Linville Creek and land based BMP practices.

4.1.2 Residential Working Group

The first meeting of the Residential Working Group met November 27, 2012 at the Linville Edom Ruritan Hall in Linville, Virginia. The 12 attendants consisted of citizens, members of the residential community, the Shenandoah Valley Soil and Water Conservation District, VADEQ, VDH, VADCR, and MapTech, Inc. Discussion focused on septic system maintenance, straight pipe detection, and potential residential BMPs and outreach strategies.

The second meeting took place on January 20, 2013 at the Linville Edom Ruritan Hall in Linville, Virginia. Fourteen (14) members were in attendance. The group discussed the septic, pet waste and stormwater BMP estimates that had been prepared for the Linville Creek watershed. Potential pilot projects were discussed including neighborhood pet waste stations, riparian buffer plantings and rain gardens.

4.2 Steering Committee

The purpose of the Steering Committee was to provide guidance on the content and presentation of the final IP and ensure that the working group recommendations were appropriately incorporated into the plan. The Steering Committee consisting of fourteen (14) attendants met on April 16, 2013 at the Linville Edom Ruritan Hall in Linville, Virginia. The committee reviewed the Public Document which some considered too long and encouraged a one-page flyer summary. A home age class database was developed to be used to promote septic tank pump-outs. It was encouraged that regular TMDL-IP meetings be held to promote and track implementation.

The minutes from the working groups, public, and steering committee meetings and the reports can found in **Appendix A**.

4.3 Summary

Varied opinions were voiced throughout the public participation meetings regarding the IP process. Most members of the working groups agreed that the cornerstone of the IP is cultivating public involvement and education and encouraging commitment and partnerships among the citizens and government agencies in the watershed in order to reduce fecal bacteria pollution. An assertion to individual responsibility provides a foundation for building partnerships among citizens, businesses, interest groups, and government agencies. It can also cultivate voluntary implementation and long-term support for reducing bacteria levels and restoring water quality in the Linville Creek watershed.

5. ASSESSMENT OF IMPLEMENTATION ACTION NEEDS

An important part of the Implementation Plan is the identification of specific best management practices and associated technical assistance needed to improve water quality in the watersheds. Since this plan is designed to be implemented by landowners on a voluntary basis, it is necessary to identify management practices that are both financially and technically realistic and suitable for this particular community. As part of this process, the costs and benefits of these practices must be examined and weighed. Once the best practices have been identified for implementation, the BMPs needed in order to meet the water quality goals established during the TMDL study were quantified.

5.1 Identification of Control Measures

Potential control measures or best management practices (BMPs), their associated costs and efficiencies, and potential funding sources were identified through review of the TMDL, input from Working Groups, and literature review. Control measures were assessed based on cost, availability of existing funds, reasonable assurance of implementation, and water quality impacts. Some control measures were indicated or implied by the TMDL allocations, while others were selected through a process of stakeholder review and analysis of effectiveness in these watersheds. These measures are discussed in **sections 5.1.1** and **5.1.2**, respectively.

5.1.1 Control Measures Implied by the TMDL

The reductions in fecal bacteria identified by the TMDL studies dictated some of the control measures that must be employed during implementation. In order to meet the reductions in direct bacteria deposition from livestock, some form of stream exclusion is necessary. Fencing is the most obvious choice; however, the type of fencing, distance from the stream bank, and most appropriate management strategy for the fenced pasture are less obvious. The 100% reduction in loads from straight pipes, failing septic systems, sewer leaks, and sewer overflows is a pre-existing legal requirement as well as a result of this TMDL. This reduction indicates that all illicit discharges (*i.e.*, straight pipes and cross-connections) in the watersheds should be corrected, and that all onsite sewage treatment systems (OSTS) (*e.g.*,

septic systems and alternative waste treatment systems) and sewer infrastructure must be maintained in proper working condition.

While it is recognized that farmers will want to minimize the cost of fencing and the amount of pasture lost, any fencing installed through the use of cost-share programs should follow established NRCS specifications and be located 10-ft from the stream bank, at a minimum, as is specified in existing Virginia cost-share programs.

An alternative water source will typically be required where pasture is fenced off from streams. The main criterion is that the system be dependable. Water systems alone (*i.e.*, with no streamside fencing) have been shown to reduce the amount of time cattle spend in the stream by as much as 50 to 80%. This is not a large enough reduction to meet all of the TMDLs. It should be restated here that it is recommended that all fencing, even that which is installed solely at the landowner's expense, be placed at least 10-ft from the stream. The inclusion of a buffer helps to reduce bacteria, as well as sediment loads in runoff. The incorporation of effective buffers could reduce the need for more costly control measures.

From an environmental perspective, the best management scenario would be to exclude livestock from the stream bank 100% of the time and establish permanent vegetation in the buffer area. This prevents livestock from eroding the stream bank, provides a buffer for capturing pollutants in runoff from the pasture, and establishes (with the growth of streamside vegetation) one of the foundations for healthy aquatic life. From a livestock-production perspective, the best management scenario is one that provides the greatest profit to the farmer. Obviously, taking land (even a small amount) out of production is contrary to that goal. However, a clean water source has been shown to improve milk production and weight gain. Clean water will also improve the health of animals (*e.g.*, cattle and horses) by decreasing the incidence of waterborne illnesses and exposure to swampy areas near streams. Additionally, intensive pasture management, which becomes possible with an alternative water source, has been shown to improve overall farm profitability and environmental impact. From a part-time farmer's perspective, the best management scenario is one that requires minimal input of time. This would seem to preclude intensive pasture management; however, those farmers who have adopted an intensive pasture-management system typically

report that the additional management of the established system amounts to "opening a gate and getting out of the way" every couple of days. Additionally, the efficient use of the pasture often means that fewer supplemental feedings are necessary. Among both part-time and full-time farmers there are individuals who are hesitant to allow streamside vegetation to grow unrestricted because of aesthetic preferences or because they have spent a lifetime preventing this growth. However, given the reductions needed in pollutant (*i.e.*, fecal bacteria) delivery to the stream, a vegetated buffer will be needed. For planning purposes, it was assumed that a vegetated buffer would be established in conjunction with stream fencing.

Correction of sewer overflows and leaks is an ongoing effort of the entities charged with the maintenance and operation of these systems. This was not identified as a significant problem in the TMDL. The options identified for correcting illicit discharges and failing septic systems included: repair of an existing septic system, installation of a septic system, connection to a sewer system and installation of an alternative waste treatment system.

5.1.2 Control Measures Selected through Stakeholder Review

In addition to the control measures that were directly indicated by the TMDL, a number of measures were needed to control fecal bacteria from land-based bacteria sources. Various scenarios were developed and presented to Working Groups. All scenarios began with implementation of the measures indicated by the TMDL. Next, specific sources of fecal bacteria were addressed where highly economic practices were identified. For instance, a residential pet waste program was specified to educate citizens on proper disposal of pet wastes. Additionally, use of pet waste composters and neighborhood pet waste stations in the Town of Broadway will be encouraged.

Beyond this level of control for the pollutants of interest, practices that require the control or treatment of runoff are the primary tools available. One additional BMP was improved pasture management. The improved pasture management BMP is considered an enhancement of a grazing land management system. Along with the infrastructure provided by a grazing land management system, improved pasture management includes:

- Maintenance of an adequate forage height (suggested 3-inch minimum grass height) during growing season.
- Application of lime and fertilizer according to soil test results.
- Mowing of pastures to control woody vegetation.
- Distribution of manure through managed rotational grazing.
- Reseeding due to severe drought if necessary.

Currently, improved pasture management is not a standalone BMP available through the Virginia Agricultural BMP Cost-Share program. However, it is eligible for funding when used with the LE-1T or LE-2T grazing land protection practice and is considered an enhancement of this practice. Employing the pasture management practices listed above can produce significant economic gains to producers at a very low investment cost. The final set of control measures identified and the efficiencies used in this study to estimate needs are listed in **Table 5.1**. "Direct Reductions" are those that reduce the load of pollutant from a specific source to the stream itself or to the land. "Buffer" practices control pollutants through both a land conversion and treatment of runoff from an upstream area. "Runoff Treatment" measures are those that either treat runoff from a given land area (*e.g.*, retention ponds) or treat runoff based on changing the runoff-producing characteristics of the land (*e.g.*, improved pasture management).

Table 5.1 Potential control measure costs and efficiencies in removing *E. coli*.

Type Description	Bacteria Reduction Efficiency	Sediment Reduction Efficiency	Reference	Unit	Unit Cost
Agricultural BMPs					
Livestock Exclusion (LE-1T)	100%	0%	1	system	$27,232
Livestock Exclusion (LE-2T)	100%	0%	1	system	$21,823
Livestock Exclusion (WP-2T)	100%	0%	1	system	$6,214
Livestock Exclusion (CREP, CRSL-6)	100%	0%	1	system	$42,311
Improved pasture management (SL-10T, EQIP 528)	50%	50%	5,8	acre	$100
Loafing Lot Management Systems	75%	40%	6,16,7	system	$109,000
Permanent Vegetative Cover on Critical Areas (SL-11)	N/A	N/A	13	acre	$1,200
Reforestation of Erodible Pasture (FR-1)	99%	N/A	1	acre	$560
Manure Storage, Beef (WP-4)	80%	75%	5,8	system	$58,000
Manure Storage, Poultry (WP-4)	80%	75%	5,8	system	$20,000
Sediment Retention Ponds, Pasture (WP-5)	70%	80%	10,5	acre-treated	$840
Permanent veg. cover on cropland (SL-11)	N/A	N/A	13	acre	$175
Conservation Tillage, No Till (SL-15)	61%	61%	6	acre	$100
Cover Crops (SL-8)	N/A	20%	7	acre	$30
Riparian buffer, forested (CCI-FRB-1)	99%	N/A	1	acre	$1,750
Riparian buffer, grass (CCI-HRB-1)	50%	50%	15	acre	$250
Residential BMPs					
Septic Tank Pump-Out (RB-1)	5%		2	system	$250
Septic System Installation (RB-4)	100%	100%	1,2	system	$8,000
Septic System Repair (RB-3)	100%	100%	1,5	system	$3,000
Sewer System Connection (RB-2)	98%	100%	1,5	system	$5,600
Alternative Waste Treatment Sys. (RB-5)	98%	100%	1,2	system	$23,000
Bioretention Filter	85%	85%	9,8	acre-treated	$20,000
Rain Garden	70%	70%	17	system	$8,000
Riparian Buffer, Residential	50%	50%	12	acre	$1,000
Neighborhood Pet Waste Station	100%	N/A	1	station	$250
Pet Waste Composter, Residential	100%	N/A	4	composter	$75
Pet Waste Composter, Commercial	100%	N/A	1	composter	$10,000
Pet Waste Education Program	NA	N/A	3	program	$1,000
Streambank BMP					
Streambank Stabilization (WP-2A)	NA	2.55 lbs/ft/yr	14	linear ft of streambank	$150

Notes:

1. Removal efficiency is defined by the practice.
2. VADCR and VADEQ TMDL Implementation Plan Development Guidance Manual

3. Modified from Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.

4. Mill and Hawksbill TMDL-IP, MapTech, September 13, 2007

5. Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/

6. Chesapeake Bay Model version 4.3 BMP efficiencies

7. Chesapeake Bay Model Scenario Builder NPS BMPs.

8. Bacteria efficiency estimated based on sediment and nutrient efficiency

9. US EPA. "Storm Water Technology Fact Sheet Bioretention." (1999): 8.

10. Center for Watershed Protection. 2007. National Pollutant Removal Performance Database Version 3.

12. Spout Run NFWF proposal, NRCS cost list.

13. NRCS cost list.

14. Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/

15. Fiener, P., Auerswald, K. Effectiveness of grassed waterways in reducing runoff and sediment delivery from agricultural watersheds. J. Environ. Qual. 32:927-936 (2003).

16. North River TMDL IP, MapTech, July 5, 2001

17. Hunt, William F, Jonathan T Smith, and Jon Hathaway. City of Charlotte Pilot BMP Monitoring Program , Mal Marshall Bioretention Final Monitoring Report. City of Charlotte, 2007.

5.2 Quantification of Control Measures

The quantity of control measures recommended during implementation was determined through spatial analyses, modeling alternative implementation scenarios, as well as input from Working Group members. Spatial analyses included the processing of data that included land use, census data, stream networks, and elevation, along with data archived in the VADCR Agricultural BMP Database and TMDL development documents. The map layers and archived data were combined to establish the number of control measures recommended overall, in the watershed, and in each subwatershed, where appropriate. Estimates of the amount of on-site treatment systems, sewer connections, streamside fencing and number of full livestock exclusion systems were made through these analyses. The quantities of additional control measures were determined through modeling alternative scenarios and applying the related reduction efficiencies to their associated loads.

Implicit in the TMDL is the need to avoid increased delivery of pollutants from sources that have not been identified as needing a reduction, and from sources that may develop over time, as implementation proceeds. One potential for additional sources of the pollutants identified is future residential development. Care should be taken to monitor development

and its impacts on water quality. Where residential development occurs, there is potential for additional pollutant loads from pet waste, failing septic systems, sewer line overflows and leaks.

5.2.1 Agricultural Control Measures

5.2.1.1 Livestock Exclusion BMPs

DCR estimated the fencing requirements through spatial analysis of land uses, the stream network, and archived data. To estimate fencing requirements, the stream network was overlaid with land use. Stream segments that flowed through or adjacent to land use areas that had a potential for supporting cattle (*e.g.*, improved pasture) were identified. If the stream segment flowed through the land-use area, it was assumed that fencing was required on both sides of the stream, while if a stream segment flowed adjacent to the land-use area, it was assumed that fencing was required on only one side of the stream. These assumptions were further refined to examine size of resultant pasture and existing BMPs. Not every land-use area identified as pasture has livestock on it at any given point in time. However, it is assumed that all pasture areas have the potential for livestock access. Aerial imagery and input from local agency representatives and citizens were used to verify the analyses. A map of potential streamside fencing required for the Linville Creek Watershed is shown in **Figure 5.1**. A total estimate of 310,269 feet or 58.8 miles of streamside fence would be required to exclude cattle from the streams.

Several different fencing options are available through state and federal programs.

- *Livestock Exclusion with Riparian Buffers for TMDL Implementation* (**LE-1T**) systems include streamside fencing, cross fencing, an alternative watering system, and requires a 35-ft buffer from the stream. It offers 85% cost share and is only available in targeted TMDL watersheds with Implementation Plans.

- The *Stream Exclusion with Grazing Land Management* (**SL-6T**) practice has similar features as the LE-1T practice, but offers waste storage and cost-share up to 75%.

- *Livestock Exclusion with Reduced Setback Practice for TMDL Implementation* (**LE-2T**) systems are only available in targeted TMDL areas with Implementation Plans. This practice requires a 10 foot setback for stream fencing. Cost share is provided for stream fencing, cross fencing, and off-stream water at a rate of 50%.

- The *Streambank Protection for TMDL Implementation* (**WP-2T**) systems include streamside fencing, hardened crossings, and a 35-ft buffer from the stream. The WP-2T practice is only available in TMDL targeted implementation areas (like this watershed). This practice includes a 75% cost-share and an up-front cost share payment of 50 cents per linear foot of fence installed to assist in covering anticipated fencing maintenance costs. In cases where a watering system already exists, a WP-2T system is a more appropriate choice.

- The *Conservation Reserve Enhancement Program* (**CREP**) is a federal cost-share option. CREP systems include streamside fencing, watering troughs, and buffer-area tree plantings. It requires excluding livestock from the stream and maintaining the minimum 35-ft buffer for the length of the contract period. This practice includes up to a 75% cost-share, one-time payment of 40% of eligible costs, a one-time sign-up payment of $100 per acre, *and* an annual rental payment of up to $100 per acre.

The VADCR Agricultural BMP Database was utilized to determine typical characteristics (e.g., streamside fencing length per practice) of full livestock exclusion systems. In addition, DCR used spatial analysis of land uses to estimate the fence length needed.

DCR obtained tax parcel data from Rockingham County, which was used to determine the number of systems needed (one system per parcel). The type of system was determined based the tax parcel acreage. For the smallest parcels (1-6 acres), it was determined that installing off stream watering would be impractical, making the WP-2T practice the most practical since it offers a limited access point on the stream for watering. For parcels 7-36 acres, the LE-2T practice was determined to be the best option since these landowners may have concerns about giving up 35 feet of land next to the stream. For larger parcels (40-89 acres), the LE-1T and SL-6T practices were determined to be the best option, while CREP was recommended for parcels greater than 90 acres since additional incentives for wider buffers are available through this program. These groupings were refined based on input from the agricultural working group to account for the fact that landowners in the headwaters of Linville Creek may be more interested in the limited setback allowed with the LE-2T practice since these landowners do not have to worry about frequent flooding and washing out of fencing.

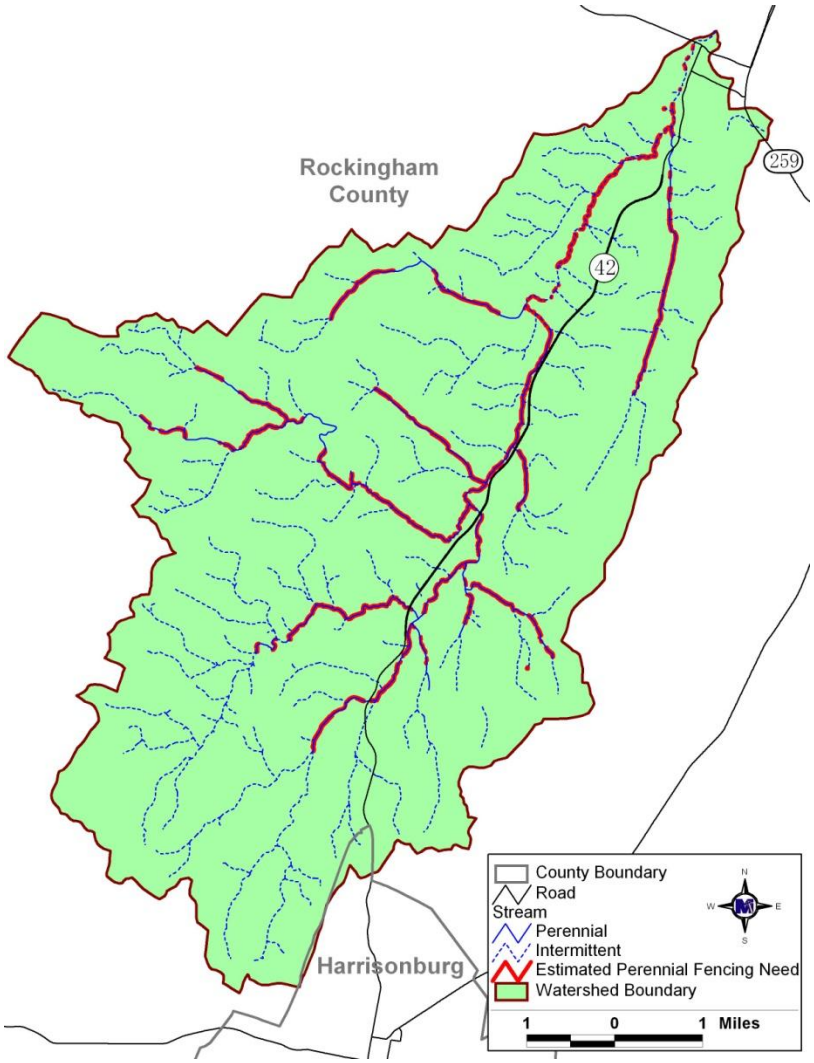


Figure 5.1 Potential streamside fencing for perennial streams in the Linville Creek Watershed.

The estimated length of fencing needed on perennial streams (those that flow year round) and a small portion of intermittent streams in the Linville Creek watershed is approximately 268,557 feet or 50.9 miles. This estimate is based on the fencing of all streams running through pasture in the watershed. A total of 19 fencing systems have already been installed in the watershed through the state cost share program, totaling 41,713 feet or 7.9 miles.

Based on stream length and pasture size, parcels were allocated to Grazing Land Protection Systems (LE-1T and LE-2T), Stream Protection Systems (WP-2T), or Conservation Reserve Exclusion Protection Systems (CREP). The LE-1T system includes streamside fencing, cross fencing, an alternative watering system, and a 35-ft buffer from the stream. The LE-1T

offers 85% cost share and is only available in targeted TMDL watersheds with implementation plans. It was estimated that 48 LE-1T systems were needed (**Table 5.2**). The LE-2T system includes the same items as LE-1T, but only requires a 10-ft buffer and is more flexible in fencing materials used. The LE-2T offers a 50% cost share in TMDL watersheds with implementation plans. It was estimated that 40 livestock exclusion systems would be accomplished through the installation of LE-1T systems. The Stream Exclusion with Grazing Land Management (SL-6T) practice has features similar to the LE-1T practice, but offers waste storage and cost-share up to 75%. The WP-2T systems include streamside fencing, hardened crossings, and a 35-ft buffer from the stream. The WP-2T practice is only available in TMDL targeted implementation areas such as the Linville Creek watershed. This practice includes an up-front cost share payment of 50 cents per linear foot of fence installed to assist in covering anticipated fencing maintenance costs. In cases where a watering system already exists, a WP-2T system is a more appropriate choice. It was estimated that 19 WP-2T systems were needed. Fencing through the Conservation Reserve Enhancement Program (CREP) is an option in the watershed provided a 35-ft setback is used. The Conservation Reserve Program (CRP) is another alternative for landowners who do not want to install a 35-ft buffer but this program does require a 20-ft buffer. It was estimated that 31 CREP systems were needed.

The breakdown of number of the different exclusions systems that are expected to be LE-1T, LE-2T, WP-2T, or CREP in the Linville Creek watershed is presented in **Table 5.2**. In addition, it was estimated that 7.5% (23,270 feet) of all pre-existing and implementation-installed fencing would need to be replaced during the length of the project.

Table 5.2 Estimation of streamside fence and number of full exclusion systems required in the Linville Creek.

Best Management Practice	Systems	Feet of Fencing
LE 1T/SL-6	40	82,979
LE 2T	48	63,531
WP-2T	19	10,391
CREP	31	111,656
Total	138	268,556

5.2.1.2 Land-Based BMPs

The Linville Creek watershed TMDLs recommend reductions to land-based bacteria and sediment loads from pasture and cropland. In order to meet these recommendations, the BMPs in **Table 5.3** must be implemented. One practice that is expected to have a substantial impact on water quality is *improved pasture management*. It is anticipated that this improved management will take the form of both rotational grazing systems and rotational loafing lot systems. Several BMPs, including *loafing lots* and *manure storage facilities*, can be applied to farmland to help prevent soil and bacteria from ending up in streams. The establishment of vegetation including trees on pasture areas that are steep, eroded or barren protects the acreage from losing soil and bacteria. Practices included in the implementation strategy for these sites include *permanent vegetative cover on critical areas*, and *reforestation of erodible pasture*. Forested and grass buffers act as filters, trapping bacteria and sediment before it runs into the stream. When considering the effectiveness of a vegetated buffer in trapping pollutants, it is important to consider the area that will be draining to the buffer. For modeling purposes, it was assumed that a typical buffer would be capable of receiving and treating runoff from an area four times its width. For example, a buffer that was 35 feet wide and 1,000 feet long would treat runoff from an area that was 140 feet wide and 1,000 feet long. Beyond four times the buffer width, it was assumed that the runoff would be in the form of channelized flow rather than the sheet flow that a buffer can filter.

Conservation tillage involves managing the intensity (frequency and aggressiveness) of soil-disturbing activities related to residue management, seedbed preparation, nutrient application, planting, and pest control while planting and growing crops. Employing conservation tillage helps prevent erosion which also helps keep bacteria found in manure fertilizers from running off the land. Benefits include improved soil quality and reductions in time, fuel, and production costs.

Sediment retention control structures on pasture-land allow time for the sediment and bacteria to settle out from the captured runoff, before it flows into streams. These retention ponds have several potential benefits, including: recreational uses such as fishing, water sources, and aesthetics.

Many agricultural BMPs qualify for financial assistance. It is recommended that participants discuss funding options with experienced personnel at their local SWCD in order to choose the best option.

The Linville Creek TMDLs recommend reductions to land-based bacteria loads. In order to meet these recommendations, the BMPs in **Table 5.3** must be implemented. One category of practices that is expected to have a substantial impact on water quality improvement is improved pasture management. In order to fully meet the TMDLs, sediment retention control structures on pasture have been included in the list of agricultural land-based BMPs. While the inclusion of this BMP in the Implementation Plan will increase overall implementation costs, it will be effective in removing sediment and bacteria from pasture runoff.

Table 5.3 Agricultural land-based BMPs for the Linville Creek Watershed.

Land use	Control measure	Unit	Extent needed
Pasture	Improved pasture management	Acres	9,150
	Loafing lot management system	System	14
	Permanent vegetative cover on critical areas	Acres	584
	Reforestation of erodible pasture	Acres	584
	Manure storage facility (beef)	Facility	11
	Manure storage facility (non-permitted poultry)	Facility	4
	Sediment retention, erosion or water control structure	Acres	100
Cropland	Permanent vegetative cover on cropland	Acres	188
	Continuous no till	Acres	2,407
	Cover crops	Acres	1,584
	Riparian buffers, forest	Acres	5
	Riparian buffers, grass filter strip	Acres	46

5.2.2 Residential Control Measures

The Linville Creek bacteria TMDL identified three sources of bacteria from residences: failing septic systems, straight pipes, and pets. **Table 5.4** shows the number of septic systems, straight pipes and pets in the watershed.

Table 5.4 Residential bacterial waste sources in the Linville Creek Watershed.

Homes with Septic Systems or Straight Pipes	Failing Septic Systems	Straight Pipes	Pets
1,494	329	7	1,815

5.2.2.1 BMPs to Correct Failing Septic Systems and Straight Pipes

All straight pipes and failing septic systems must be identified and corrected during implementation since a 100% load reduction from these sources was deemed necessary to meet the TMDL bacteria goal. The BMPs in **Table 5.5** have been identified to correct failing septic systems and straight pipes: septic system repairs, new septic system installation, connect to public sewer system and alternative waste treatment systems. It was estimated that 40% of the failing septic systems would need to be repaired. Of the remaining failing septic systems, 20% would be corrected with conventional septic systems and 38% would be corrected with alternative wastewater treatment systems. It was also estimated that 2% would be able to connect to a public sewer system in the future. Straight pipe corrections are also identified in the table.

Table 5.5 Residential septic BMPs needed in the Linville Creek Watershed.

Best Management Practice	Septic Systems	Straight Pipes
Septic System Pump Out	300*	N/A
Septic System Installation	66	1
Septic System Repair	131	N/A
Septic System Hookup to Public Sewer	7	0
Alternative Waste Treatment System	125	6

Notes: * .. Input from Residential Working Group

5.2.2.2 Land-Based Residential BMPs

In addition to the residential septic source control measures, it was recognized that educational efforts would be vital to the successful implementation of the Linville Creek TMDLs. The residential education program includes a program addressing the benefits of cleaning up after pets and maintaining septic systems. The residential education program

may also include a combination of educational materials distributed to pet owners, signage describing water quality concerns related to pet waste, and disposal bags and receptacles in areas of high pet traffic. In addition, pet waste composters are also proposed to help eliminate pet waste in homeowner's yards and kennels, instead of just in public places. Pet waste composters could be distributed to households in this watershed with pets through partnerships with local stores selling pet food, the County Animal Shelter, and the Society for the Prevention of Cruelty to Animals (SPCA). While the watershed contains an estimated 1,494 houses with standard septic systems that should be pumped out regularly, based on input from the residential working group the project target was set at 300 pump-outs (5% of systems).

A Community Pet Waste Education Program is recommended in Linville Creek in order to encourage pet owners to pick up after their pets. This program includes the distribution of educational materials on proper disposal of pet waste to pet owners, kennel operators, and grooming facilities. Neighborhood pet waste disposal stations and pet waste composters also encourage pet owners to pick up after their animals. A pet waste composter allows a homeowner to collect their pet's waste and safely compost it outside. Traditional composters may also be used to treat pet waste. In addition, larger scale commercial pet waste digesters may be used by groomer and boarding facilities, and veterinary offices. Potential locations for these BMPs were identified primarily centered on the Town of Broadway where the most compact residential development has occurred (**Table 5.6**).

5.2.2.3 Residential Stormwater BMPs

Aside from septic and pet waste BMPs, it is also necessary to implement BMPs to filter and treat runoff from residential areas, to further eliminate sediment and bacteria to the stream. Riparian buffers are excellent filters that can be installed at low cost next to the stream. A basic spatial analysis of opportunities for buffers in residential areas was performed by DCR using Geographic Information Systems. Aerial imagery collected in 2011 was used to identify residential areas next to the stream lacking streamside vegetation. In addition, opportunities for bioretention filters and rain gardens were identified. **Table 5.7** provides a summary of the extent of stormwater practices recommended for the Linville Creek

watershed along with potential locations for projects. Potential project locations are generally focused on areas of concentrated development in and around Broadway.

Table 5.6 Pet waste BMPs for the Linville Creek watershed and potential locations

BMP description	Units	Extent	Potential locations
Neighborhood pet waste station	Station	4	Walnut Drive subdivision Alger Lane subdivision East Springbrook Rd subdivision McKinley Drive subdivision
Pet waste composter	Composter	49	Jewelry Drive subdivision Robin Roost Court subdivision Other residential lots < 2 acres
Pet waste composter (commercial)	Composter	5	Tails of Broadway Pet Creations Broadway Veterinary Hospital Love on a Leash Dog training Puppy Luv Grooming and Boarding
Pet waste education program	Program	1	Watershed-wide

Table 5.7 Stormwater BMPs for the Linville Creek watershed.

BMP description	Units	Extent needed	Potential locations
Bioretention filter	Filters	5	Broadway High School J Frank Hilyard Middle School (back side) Broadway Volunteer Fire Department Pilgrim's Pride Corporation
Rain gardens	Gardens	8	McKinley Drive subdivision Robin Roost Ct. subdivision Jewelry Drive subdivision Other residential lots < 2 acres
Riparian buffers	Acres	15	Broadway Park Behind Subway and Broadway Tire and Automotive Faith Baptist Church

5.2.3 Streambank Stabilization Measures

The Linville Creek sediment TMDL requires a 25% reduction in sediment from stream channel erosion. In order to meet these recommendations, streambank stabilization should be combined with livestock exclusion practices. Assuming the planned livestock exclusion on 59 miles of stream occurs on currently eroding streambanks, the entire exclusion program would reduce sediment from stream erosion by an estimated 6%. Most of the stream segments in need of streambank stabilization measures are located along the main stem of Linville Creek. Because streambanks are also found to be eroding in residential areas, these areas were allocated 15% of the stabilization extent based on the distribution of land use. All the BMPs in **Table 5.8** should be implemented; although a staged approach to implementation is described in **Chapter 6** of this document.

Table 5.8 Streambank stabilization BMPs for the Linville Creek watershed.

BMP description	Extent needed	Agricultural Areas	Residential Areas
Streambank Stabilization	3,000 ft	2,538 ft	462 ft

5.3 Technical Assistance and Education

Stakeholders agree that technical assistance and education is the key to getting people involved in implementation. There must be a proactive approach to contact farmers and residents to articulate exactly what the TMDL means to them and what practices will help meet the goal of improved water quality. The working groups recommended several education/outreach techniques, which will be utilized during implementation. Outreach at County Fairs has been successful in other watersheds in the past. There are also opportunities for joint events with the Virginia Cooperative Extension Service. It may also be possible to involve the local Ruritan and Rotary clubs. A program should be established to educate septic and alternative waste treatment system installers on the maintenance requirements expected of the homeowner. Many alternative waste treatment system owners are not aware of the maintenance required. Citizen monitoring can be used to further engage local landowners, and to identify "hot spots" for *E.coli* bacteria in the watershed and areas where excessive sediment loading is occurring. Several landowners in Linville Creek

expressed an interest in conducting bacteria and biological monitoring in the watershed during the process of developing this plan. Once problem areas are identified, outreach efforts could be targeted towards these reaches of the stream including neighbor to neighbor communication. An engaged citizen monitoring and outreach network could serve as a very effective and efficient means of reaching landowners in the watershed who are contributing significant amounts of bacteria or sediment to the creek.

The following tasks associated with agricultural, residential and industrial programs were identified.

Agricultural Programs

1. Make contact with landowners in the watershed to make them aware of implementation goals, cost-share assistance, and voluntary options that are beneficial.
2. Provide technical assistance for agricultural programs (*e.g.*, survey, design, layout, and approval of installation).
3. Develop educational materials & programs.
4. Organize educational programs (*e.g.,* County Fair, presentations at joint VCE events or club events).
5. Distribute educational materials (*e.g.,* informational articles in FSA or Farm Bureau newsletters, local media).
6. Handle and track cost-share.
7. Assess and track progress toward BMP implementation goals.
8. Coordinate use of existing agricultural programs and suggest modifications where necessary.

Residential Programs

1. Identify straight-pipes and failing septic systems (*e.g.*, contact landowners in older homes, septic pump-out program).
2. Handle and track cost-share.
3. Develop educational materials & programs.
4. Organize educational programs (*e.g.*, demonstration septic pump-outs, nutrient management, pet waste control).
5. Distribute educational materials (*e.g.*, informational pamphlets on TMDL IP and on-site sewage disposal systems).
6. Assess progress toward implementation goals.

The staffing needs to implement the agricultural and residential components of the plan were estimated based on discussions with stakeholders and the staffing levels used in similar

projects. Staffing needs were quantified using full time equivalents (FTE), with one FTE being equal to one full-time staff member. It was determined that one FTE for residential and stormwater BMPs, and one FTE for agricultural and streambank stabilization BMPs would be needed to provide technical assistance in the watersheds for each year of Stages 1 and 2 of implementation.

5.4 Cost Analysis

5.4.1 Agricultural Control Measures

Streamside fencing through or adjacent to pasture with potential livestock access was translated and quantified into full livestock exclusion systems as described in **Section 5.2.1.1**. The costs for the LE-1T, LE-2T, WP-2T, and CREP systems were estimated based on the cost of systems already in place in the Linville Creek watershed. The cost of an LE-1T and LE-2T systems were estimated at $27,232 and $21,823 respectively. Through VADCR input it was assumed that the costs for hardened crossings would be included in WP-2T, and improved pasture management (cross fencing) would be included in the LE-1T, LE-2T, and CREP systems. WP-2T and CREP systems were estimated to cost $6,214 and $42,311, respectively.

The cost of livestock exclusion systems including fence installation, repair, and maintenance does not include the cost of taking land (*e.g.,* 35-ft buffer area) out of production. The cost of fence maintenance was identified as a deterrent to participation. Financial assistance possibilities for maintaining fences include an annual 25% tax credit for fence maintenance and conservation easements where the landowner is paid a percentage of the land value to leave it undisturbed. Additionally, the Streambank Protection (WP-2T) cost-share practice will be available as part of the implementation project and provides an upfront incentive payment to maintain stream fencing. It was estimated that 7.5 % of all fencing length would need to be replaced during the length of the project. The cost per foot for streamside fence maintenance is estimated at $3.50/ft.

The remaining costs outlined in **Table 5.9** were determined through literature review (**Table 5.1**), analysis of the Virginia Agricultural BMP Database, state-wide average NRCS component cost estimates, and discussion with stakeholders. The number and type of

practices proposed for the watershed were determined through discussions with local personnel and data from the Virginia Agricultural BMP Database.

Table 5.9 Agricultural control measure needs and costs in the Linville Creek Watershed.

Agricultural Control Measure	Unit	Cost per Unit	Units Needed
Livestock Exclusion			
LE-1T/SL-6T	System	$27,232	40
LE-2T	System	$21,823	48
WP-2T	System	$6,214	19
CREP	System	$42,311	31
Streamside Fence Maintenance	Foot	$3.50	23,270
Pasture, Runoff Control			
Improved pasture management	Acres	$100	9,150
Loafing lot management system	System	$109,000	14
Permanent vegetative cover on critical areas	Acres	$1,200	584
Reforestation of erodible pasture	Acres	$560	584
Manure storage facility (beef)	Facility	$58,000	11
Manure storage facility (non-permitted poultry)	Facility	$20,000	4
Sediment retention, erosion or water control structure	Acres treated	$840	100
Cropland, Runoff Control			
Permanent vegetative cover on cropland	Acres	$175	188
Continuous no till	Acres	$100	2,407
Cover crops	Acres	$30	1,584
Riparian buffers: forested	Acres	$1,750	5
Riparian buffers: grass filter strip	Acres	$250	46

5.4.2 Residential Control Measures

Following recommendations from the Residential Working Group and the local Virginia Department of Health, it was estimated that 40% of the failing septic systems would need to be repaired ($3,000). Of the remaining failing septic systems and straight pipes, 20% would be corrected with conventional septic systems ($8,000) and 38% would be corrected with alternative wastewater treatment systems ($23,000). It was also estimated that 2% would be able to connect to a public sewer system in the future ($5,600). The remaining costs outlined in **Table 5.10** were determined through literature review, and discussion with stakeholders.

Table 5.10 Residential control measure needs and costs in the Linville Creek Watershed.

Residential Control Measure	Unit	Cost per Unit	Units Needed
Septic			
Septic tank pump-out	Pump-out	$250	300
Conventional septic system	System	$8,000	67
Septic system repair	Repair	$3,000	131
Connection to public sewer	Connection	$5,600	7
Alternative waste treatment system	System	$23,000	131
Pet Waste			
Pet waste education program	Program	$1,000	1
Neighborhood pet waste station	Station	$250	4
Residential pet waste composter	Composter	$75	49
Commercial pet waste composter	Composter	$10,000	5
Stormwater			
Bioretention filter	Filter	$20,000	5
Rain garden	Garden	$8,000	8
Riparian buffer	Acres	$1,000	15
Pet Waste Education Program	System	$3,750	
Pet Waste Composters	Composters	$60	

5.4.3 Streambank Stabilization Measures

It is recommended that 3,000 feet of streambank stabilization be slated for urban and agricultural areas in the watershed, an amount estimated to be more than sufficient to meet the sediment TMDL goals. The cost is $150 per linear foot of streambank (**Table 5.11**).

Table 5.11 Streambank stabilization control measure needs and costs.

Control Measure	Unit	Cost per Unit	Units Needed
Streambank stabilization	linear feet	$150	3,000

5.4.4 Technical Assistance

It was determined by the working group members that it would require $50,000 to support the salary, benefits, travel, training, and incidentals for education of one technical FTE. With a need for one agricultural and one residential technical FTE per year for the watershed, the total potential cost to provide agricultural technical assistance during implementation is expected to be approximately $100,000 per year for 14 years.

5.4.5 Total Estimated Costs

The total estimated costs for the implementation of BMPs in the Linville Creek watershed are shown in **Table 5.12**. The technical assistance cost assumes that 2 FTEs are utilized for the watershed for 14 years.

Table 5.12 Total estimated costs to meet the Linville Creek Watershed *E. coli* bacteria and sediment TMDLs.

Impairment	Agricultural BMPs	Residential BMPs	Streambank Restoration	Technical Assistance	Total Cost
Linville Creek Watershed	$8,260,147	$4,290,875	$450,000	$1,400,000	$14,401,022

5.5 Benefit Analysis

The primary benefit of implementation is cleaner waters in Virginia. Specifically, *E. coli* and sediment contamination in the Linville Creek watershed will be reduced to improve water quality. **Table 5.13** indicates the cost efficiencies of the various practices being proposed in this IP. It is hard to gage the impact that reducing *E. coli* contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from *E. coli* sources through contact with surface waters should be reduced considerably. Also many of the BMPs recommended in this plan will help reduce erosion or filter sediments and nutrients from runoff water, which will help meet load reductions needed in local sediment TMDLs and the Chesapeake Bay TMDL.

Table 5.13 Cost efficiencies of control measures in units removed per $1,000 in the Linville Creek Watershed.

Control Measure	Pollutant
Agricultural	*Bacteria*
Grazing Land Protection System (LE-1T and LE-2T) and Stream Protection System (WP-2T)	4.2E+10
Improved Pasture Management	5.3E+12
Reforestation of Erodible Pasture	2.0E+12
Conservation Tillage	2.4E+11
Vegetated Buffers on Crop Land	1.8E+08
Retention Ponds - Pasture	1.8E+12
Residential	*Bacteria*
Septic System Repair	5.5E+10
Septic System Installation/Replacement	1.2E+11
Alternative Waste Treatment System Installation	4.6E+10
Sewer System Connection	1.0E+11
Pet Waste Education Program	4.8E+13
Pet Waste Composters	1.3E+12

An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural, residential and streambank restoration practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, private sewage system maintenance and stream bank stabilization will each provide economic benefits to land owners. Additionally, money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

5.5.1 Agricultural Practices

A clean water source has been shown to improve weight gain and milk production in cattle. Fresh clean water is the primary nutrient for livestock with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their body weight in summer. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and hair coat contamination with

manure (VCE, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moon blindness associated with Leptospirosis infections (VCE, 1998b). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills. In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing excludes livestock from wet, swampy environments as are often found next to streams where cattle have regular access. Keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (1998a) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7 billion to 2 billion annually or 11% of total U.S. milk production. While the spread of mastitis through a dairy herd can be reduced through proper sanitation of milking equipment, mastitis-causing bacteria can be harbored and spread in the environment where cattle have access to wet and dirty areas. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas.

Taking the opportunity to implement an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 to 40% and, consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80 % of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to 0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits by allowing higher stocking rates and increasing the amount of gain per acre. Another benefit is that cattle are closely confined allowing for quicker examination and handling. In general, many of the agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing excludes livestock from wet, swampy environments as are often found next to streams where cattle have regular access. Keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (1998a) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7 billion to 2 billion annually or 11% of total U.S. milk production. While the spread of mastitis through a dairy herd can be reduced through proper sanitation of milking equipment, mastitis-causing bacteria can be harbored and spread in the environment where cattle have access to wet and dirty areas. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas.

Taking the opportunity to instigate an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 to 40 % and, consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80 % of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to 0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits by allowing higher stocking rates and increasing the amount of gain per acre. Another benefit is that cattle are closely confined allowing for quicker examination and handling. In general, many of the agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

5.5.2 Residential Practices

The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry. In terms of economic benefits to homeowners, an

improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (e.g., not driving or parking on top of them), not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive ($250) in comparison to repairing or replacing an entire system ($3,000 to $23,000).

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation. Additionally, income from maintenance of these systems should continue long after implementation is complete. As will be discussed in greater detail in **Chapter 8**, a portion of the funding for implementation can be expected to come from state and federal sources. This portion of funding represents money that is new to the area and will stimulate the local economy. In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which, in turn, will allow for individual landowners to participate in implementation.

5.5.3 Streambank Restoration

Streambank restoration involves protection by reducing the force of water against streambanks and increasing their resistance to erosive forces. Restoration practice requires design, construction, and protection. This results in the control of soil erosion, sedimentation, and nutrient loss from surface runoff to improve water quality. Aside from improving water quality and lowering stream temperatures, streambank restoration stabilizes the stream hydrology in terms of reduced seasonal and storm variation in flow. Stabilized hydrology reduces the strength and duration of stress on banks leading to further

stabilization. The stability and reduced sediment and nutrient load are beneficial for aquatic life. Aquatic habitat is improved for organisms that live on the stream bottom and support the aquatic food web. This increase ensures minimum flow for fish habitat and a food chain to feed them. As a result, sport fishing can be sustained. Stabilized flow also supports recreational swimming, wading, and boating.

Aside from providing recreation, stabilized stream banks in combination with practices like WP-2T fencing, protect stream corridors that are bordered by agricultural or forest lands. This will result in riparian vegetation and even forest areas that benefit livestock through shade and clean, cool water. The reduced pollution of water by agricultural and forest nonpoint sources benefits both the herd manager and the wildlife that depend on these aquatic environments (VDCR, 2012).

6. MEASURABLE GOALS AND MILESTONES FOR ATTAINING WATER QUALITY STANDARDS

Given the scope of work involved with implementing these TMDLs, full implementation is expected within 18 years. The work is expected to result in de-listing the sediment impairment from the Virginia Section 305(b)/303(d) list, but not the bacteria impairment without addressing in stream wildlife contributions. However, the practices will make a significant reduction in the in-stream bacteria violation rate. Described in this section are funding sources, identification of milestones, timeline for implementation, and the targeting of control measures.

6.1 Milestones Identification

The end goals of implementation are improved water quality of the impaired waters and subsequent de-listing of the sediment impairment from the Commonwealth of Virginia's Section 305(b)/303(d) list within 18 years. Progress toward end goals will be assessed during implementation through tracking of control measure installations and continued water quality monitoring. Agricultural, residential, and stream restoration control measures will be tracked through the Virginia Agricultural Cost-Share Program.

Expected progress in implementation is established with two types of milestones: *implementation milestones* and *water quality milestones*. Implementation milestones establish the amount of control measures installed within certain timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The milestones described here are intended to achieve full implementation within 18 years.

Following the idea of a staged implementation approach, resources and finances will be concentrated on the most cost-efficient control measures first. For instance, the BST results for Linville Creek watershed indicated that humans are a source of fecal bacteria pollution in the stream. Concentrating on eliminating straight pipes and correcting failing septic systems within the first years may provide the highest return on water quality improvement with less cost to landowners. The Stage I goals for implementation will focus on correcting straight pipes and failing septic systems, implementing a pet waste control program, fencing half the

cattle out of the streams along with streambank stabilization, conservation tillage and cover crops. Stage II focuses on improving pasture management, treating erodible crop and pasture, loafing lots, waste storage systems for poultry and dairy, and completing the remaining fencing required in the Linville Creek watershed. The remaining four years composing Stage III will involve an increase in improved pasture management, and the installation of a reasonable number of retention ponds.

It is anticipated that implementation will begin for the Linville Creek watershed in July of 2013, after which three milestones will be sought over the next 18 years (**Table 6.1**). The first milestone will be seven years after implementation begins, whereby the more cost-efficient control measures will be installed, with significant reductions in bacteria and sediment anticipated. Following Stage I implementation, the steering committee should evaluate water quality improvements and determine how to proceed with Stage II. Costs for Stage II are presented in **Table 6.1**. Based on completing these two stages, the implementation in Stage III would be the final milestone which is anticipated in 2031.

Table 6.1 Implementation goals by stage for the Linville Creek Watershed.

Land Use/Sourc	Control measure	Unit	Stage I	Stage II	Stage III	Total
Streamside livestock access	LE-1T/SL-6T – Livestock exclusion	System	20.0	20.0	0.0	40
	LE-2T– Livestock exclusion	System	24.0	24.0	0.0	48
	WP-2T– Livestock exclusion	System	9.5	9.5	0.0	19
	CREP– Livestock exclusion	System	15.5	15.5	0.0	31
Pasture	Improved pasture management	Acres	0	6,000	3,150	9,150
	Loafing lot management system	System	4	9	1	14
	Permanent vegetative cover on critical areas	Acres	146	438	0	584
	Reforestation of erodible pasture	Acres	146	438	0	584
	Manure storage facility (beef)	Facility	3	8	0	11
	Manure storage (non-permitted	Facility	3	1	0	4
	Sediment retention, erosion or water control structure	Acre-treated	0	0	100	100
Cropland	Permanent vegetative cover on	Acres	188	0	0	188
	Continuous no till	Acres	2,407	0	0	2,407
	Cover crops	Acres	1,584	0	0	1,584
	Riparian buffer: forested	Acres	5	0	0	5
	Riparian buffer: grass filter strip	Acres	46	0	0	46

(continues next page)

Table 6.1 Implementation goals by stage for the Linville Creek Watershed (cont.).

Land Use/Sourc	Control measure	Unit	Stage I	Stage II	Stage III	Total
Septic systems	Septic tank pump-out	Pump-out	150	150	0	300
	Septic system repair	Repair	131	0	0	131
	Conventional septic system	System	67	0	0	67
	Alternative waste treatment system	System	131	0	0	131
	Connection to public sewer	Connection	7	0	0	7
Pet waste	Neighborhood pet waste station	Station	4	0	0	4
	Residential pet waste composter	Composter	49	0	0	49
	Commercial pet waste composter	Composter	5	0	0	5
	Pet waste education program	Program	1	0	0	1
Storm-water	Bioretention filter	Filter	5	0	0	5
	Rain garden	Garden	8	0	0	8
	Riparian buffer	Acres	15	0	0	15
Stream erosion	Streambank stabilization	Linear feet	3,000	0	0	3,000
Assistance	Technical Assistants	FTE	14	14	0	28
Violation rate by stage: *E.coli* instantaneous standard (current = 71%)			**41%**	**37%**	**37%[1]**	
Sediment reduction by: TMDL goal = 788 tons/yr (12.3%)			**100%**	**100%**	**100%**	

1 This is the lowest violation percentage obtainable once the anthropogenic sources of bacteria are addressed through maximum practicable implementation without eliminated direct wildlife loads to the creek.

The costs for the individual control measures are estimated in the following table (**Table 6.2**). The lion's share of activity is in Stages I and II which is why Technical Assistants are only slated for those two stages.

Table 6.2 Implementation costs by stage for the Linville Creek Watershed.

Land Use/Source	Control measure	Stage I	Stage II	Stage III	Total
Streamside livestock access	LE-1T	$544,640	$544,640	$0	$1,089,280
	LE-2T	$523,752	$523,752	$0	$1,047,504
	WP-2T	$59,033	$59,033	$0	$118,066
	CREP	$655,821	$655,821	$0	$1,311,641
	Fence Maintenance	$31,673	$31,673	$18,099	$81,446
Pasture	Improved pasture mgt.	$0	$600,000	$315,000	$915,000
	Loafing lot mgt. system	$436,000	$981,000	$109,000	$1,526,000
	Permanent vegetative cover on critical areas	$175,200	$525,600	$0	$700,800
	Reforestation of erodible pasture	$81,760	$245,280	$0	$327,040
	Manure storage facility (beef)	$174,000	$464,000	$0	$638,000
	Manure storage (non-permitted poultry)	$60,000	$20,000	$0	$80,000
	Sediment retention, erosion or water control structure	$0	$0	$84,000	$84,000
Cropland	Permanent vegetative cover on cropland	$32,900	$0	$0	$32,900
	Continuous no till	$240,700	$0	$0	$240,700
	Cover crops	$47,520	$0	$0	$47,520
	Riparian buffer: forested	$8,750	$0	$0	$380,700
	Riparian buffer: grass filter strip	$11,500	$0	$0	$8,750
Septic systems	Septic tank pump-out	$37,500	$37,500	$0	$75,000
	Septic system repair	$393,000	$0	$0	$393,000
	Conventional septic system	$536,000	$0	$0	$536,000
	Alternative treatment system	$3,013,000	$0	$0	$3,013,000
	Connection to public sewer	$39,200	$0	$0	$39,200
Pet waste	Neighborhood pet waste station	$1,000	$0	$0	$1,000
	Residential pet waste composter	$3,675	$0	$0	$3,675
	Commercial pet waste composter	$50,000	$0	$0	$50,000
	Pet waste education program	$1,000	$0	$0	$1,000
Stormwater	Bioretention filter	$100,000	$0	$0	$100,000
	Rain garden	$64,000	$0	$0	$64,000
	Riparian buffer	$15,000	$0	$0	$15,000
Stream [illegible]	Streambank stabilization	$450,000	$0	$0	$450,000
Assistants	Technical Assistants	$700,000	$700,000	$0	$1,400,000
Totals:		**$8,486,624**	**$5,388,299**	**$526,099**	**$14,401,022**

6.2 Timeline

Based on meeting the above milestones, an 18-year implementation plan timeline was formulated for the Linville Creek Watershed (**Figure 6.1**). The timeline describes the needs for implementation in terms of completion of the agricultural, residential and industrial control measures. **Table 6.3** shows the projected staged implementation costs for agricultural and residential control measures, including technical assistance.

Table 6.3 BMP implementation and technical assistance costs for Stage I – III (years 1 - 18) for the Linville Creek Watershed.

BMP Type	Stage I (Years 1-7)	Stage II (Years 8-14)	Stage III (Years 15-18)	Total
Agricultural	$ 3,083,249	$ 4,650,799	$ 526,099	$ 8,260,147
Residential/Urban	$ 4,253,375	$ 37,500	$ 0	$ 4,290,875
Streambank stabilization	$ 450,000	$ 0	$ 0	$ 450,000
Technical assistance	$ 700,000	$ 700,000	$ 0	$ 1,400,000
Total	$ 8,486,624	$ 5,388,299	$ 526,099	$ 14,401,022

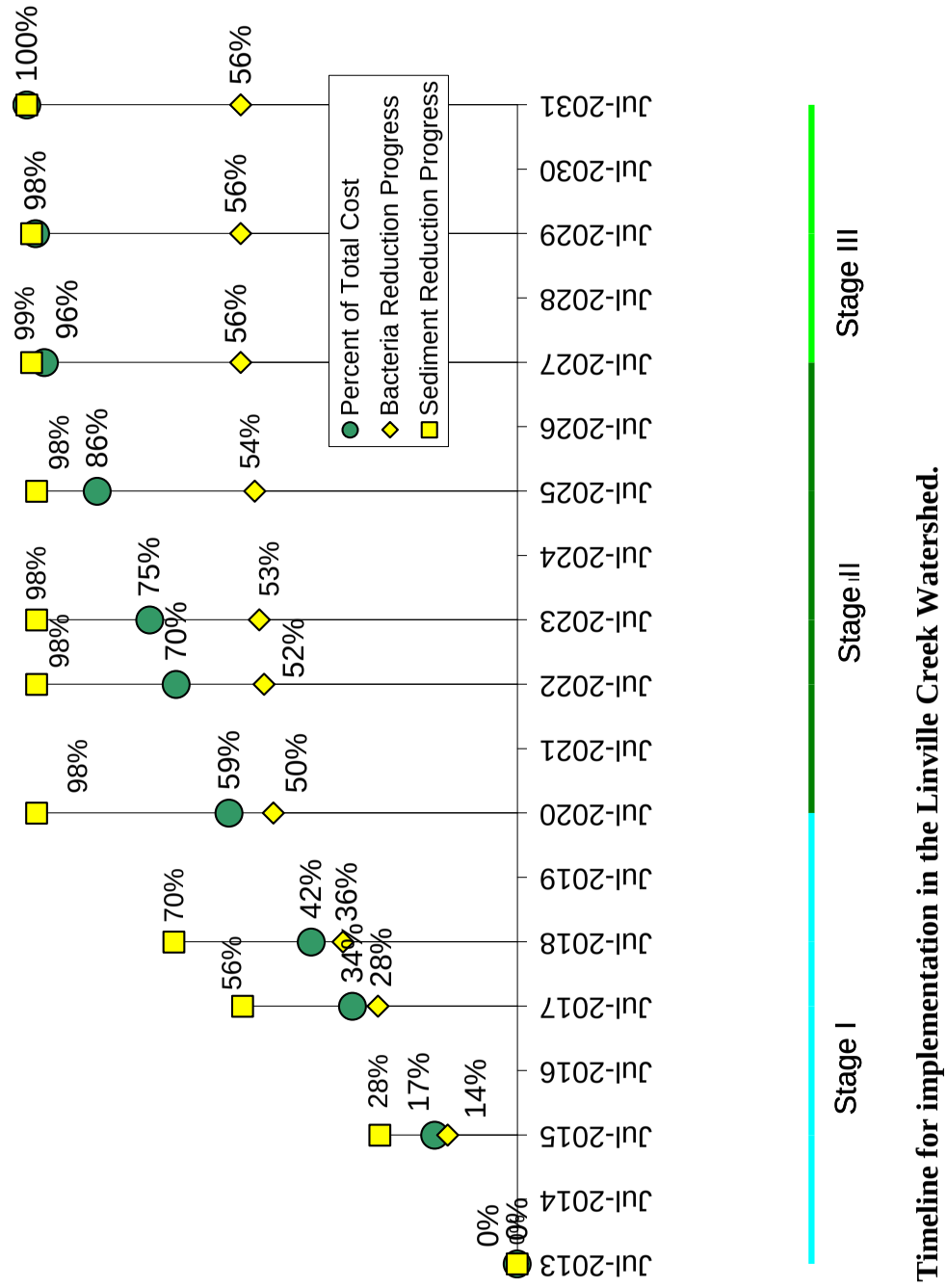


Figure 6.1 Timeline for implementation in the Linville Creek Watershed.

Table 6.4 Timeline for implementation of BMP practices in the Linville Creek Watershed.

Control Measure		Stage I	Stage II	Stage III
	Existing	Year 1-7	Year 8-14	Year 15-18
Livestock Exclusion				
Grazing Land Protection System (LE-1T, LE-2T, CREP)	0%	50%	100%	100%
Stream Protection System (WP-2T)	0%	50%	100%	100%
Streamside Fence Maintenance	0%	39%	78%	100%
Pasture, Runoff Control				
Improved Pasture Management	0%	0%	66%	100%
Loafing Lot Management System	0%	29%	93%	100%
Permanent Vegetative Cover on Critical Areas	0%	25%	100%	100%
Reforestation of Erodible Pasture	0%	25%	100%	100%
Manure Storage Facility - Beef	0%	27%	100%	100%
Manure Storage Facility – Poultry	0%	75%	100%	100%
Retention Ponds – Pasture	0%	0%	0%	100%
Crop, Runoff Control				
Permanent Vegetative Cover on Cropland	0%	100%	100%	100%
Continuous No-Till	0%	100%	100%	100%
Cover Crop	0%	100%	100%	100%
Crop Riparian Buffer – Forest	0%	100%	100%	100%
Crop Riparian Buffer – Grass Filter	0%	100%	100%	100%

(continues next page)

Table 6.4 Timeline for implementation of BMP practices in the Linville Creek Watershed (continued).

Control Measure		Stage I	Stage II	Stage III
	Existing	Year 1-7	Year 8-14	Year 15-18
Septic Systems				
Septic Systems Pump-Out	0%	50%	100%	100%
Septic System Repair	0%	100%	100%	100%
Septic System Installation/Replacement	0%	100%	100%	100%
Alternative Waste Treatment System	0%	100%	100%	100%
Connection to Public Sewer	0%	100%	100%	100%
Pet Waste				
Neighborhood pet waste station	0%	100%	100%	100%
Residential pet waste composter	0%	100%	100%	100%
Commercial pet waste composter	0%	100%	100%	100%
Pet waste education program	0%	100%	100%	100%
Bioretention filter	0%	100%	100%	100%
Rain garden	0%	100%	100%	100%
Riparian buffer	0%	100%	100%	100%
Stream Erosion				
Streambank Restoration	0%	100%	100%	100%
Cost (% of Total)	0%	59%	96%	100%

6.3 Targeting

Implicit in the process of a staged implementation is targeting of control measures. Targeting ensures optimum utilization of resources. The Linville Creek watershed was divided into 11 subwatersheds. Targeting of critical areas for livestock fencing was accomplished through analysis of livestock population and the fencing requirements for each subwatershed. The subwatersheds were ranked in descending order based on the fence length required. If feasible, effort should be made to prioritize resources in the following order of subwatersheds as listed in **Table 6.5** and mapped in **Figure 6.2**. For example, the SVSWCD should initiate participation from farmers in subwatershed 9. The targeting priority list should be used to focus outreach promoting the cost-share programs available. Any interested parties should not be turned away if their farm is in a low ranking subwatershed.

Table 6.5 Fencing priority by subwatershed. Priority 1 is highest priority.

Subwater-shed	Beef cattle	Fencing needed (ft)	Cattle : Fence	Fencing priority
1	121	0	N/A	N/A
2	484	38,624	0.013	9
3	814	23,567	0.035	2
4	400	20,345	0.020	6
5	1,455	46,164	0.032	3
6	1,111	35,610	0.031	4
7	13	826	0.016	7
8	66	6,219	0.011	10
9	468	3,993	0.117	1
10	779	38,392	0.020	5
11	798	54,816	0.015	8

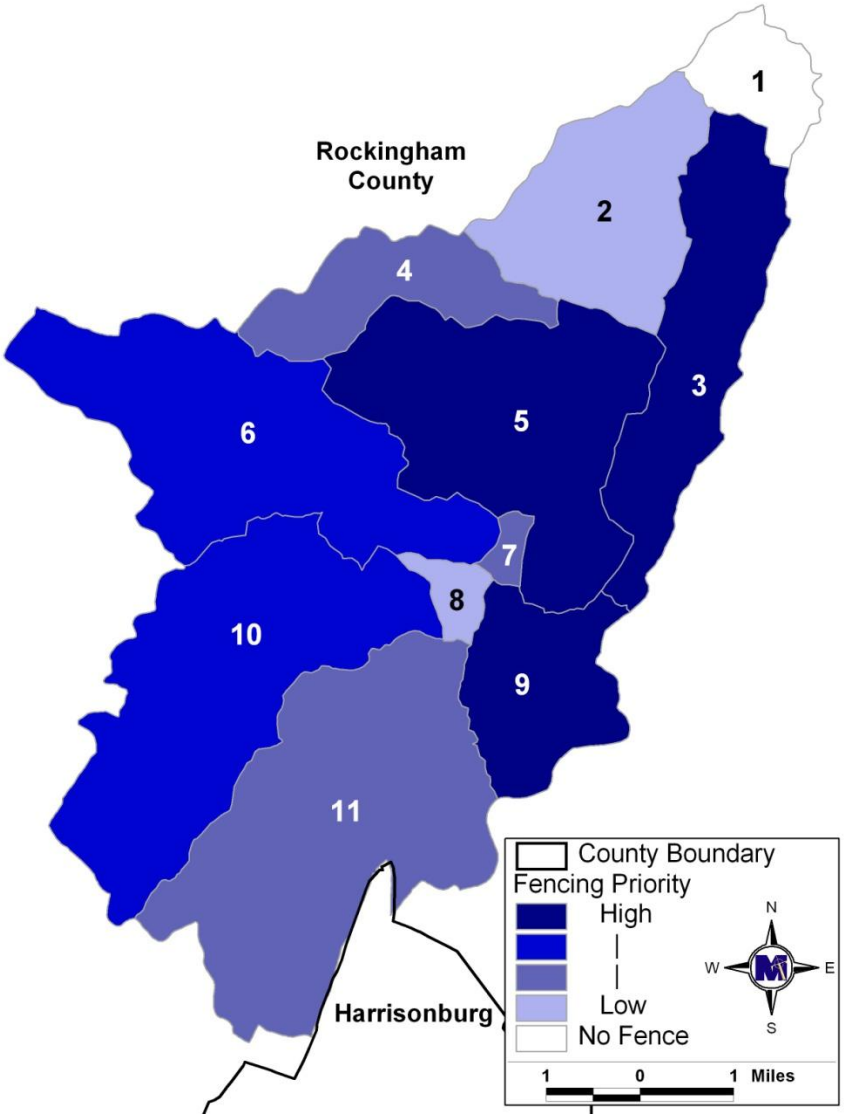


Figure 6.2 Fencing priority by subwatershed for Linville Creek. Subwatershed numbers on the map match those in priority Table 6.5.

The residential working group advised targeting of septic tank pump-outs to the older homes in the watershed where the likelihood of a septic system failure is greatest. A student intern from James Madison University assisted with the development of a mailing list based on the age of homes in the watershed using data provided by Rockingham County. This mailing list completed in April 2013 will be held by the SVSWCD office and made available to organizations interested in administering pump-out grants in the watershed. This will allow targeted mailings promoting technical and financial assistance available for septic system

maintenance to households with the greatest need. In addition, the group discussed targeting of pet waste and stormwater BMPs to areas in and around the Town of Broadway in subwatershed 1 where the densest residential and urban development has occurred. Specific neighborhoods and properties were identified for potential pet waste stations, pet waste composters, and rain gardens/bioretention filters. These projects are identified in **Table 5.6** (page **5-15**) and **Table 5.7** (page **5-15**). Should funding be pursued for residential septic and urban stormwater practices, these projects should take priority.

One method of targeting in agricultural and residential areas involves considering the cost-efficiency of specific practices. **Table 5.13** (page **5-22**) indicates the cost-efficiencies of the practices proposed in this IP. Practices with high cost-efficiencies, relative to other practices, will provide the greatest benefit per dollar invested.

page intentionally blank

7. STAKEHOLDERS AND THEIR ROLE IN IMPLEMENTATION

Achieving the goals of this effort (*i.e.*, improving water quality and removing the sediment impairment of these waters from the impaired waters list) is dependent upon stakeholder participation. The first step is to acknowledge that a water quality problem exists and realize that needed changes must be made in operations, programs, and legislation to address these pollutants. The SVSWCD has agreed to take responsibility for initiating contact to encourage landowners to install the agricultural BMPs. Technical assistance with residential septic practices could be provided by the local Health Department staff in cooperation with Friends of the North Fork of the Shenandoah River who expressed interest in administering a septic maintenance cost-share program if funds are available. VADEQ staff will take the responsibility of working with the SVSWCD and other partners in tracking implementation efforts as well as organizing the steering committee for evaluations of implementation progress. The following sections in this chapter describe the responsibilities and expectations for the various components of implementation.

7.1 Integration with Other Watershed Plans

Each watershed in the state is under the jurisdiction of a multitude of individual, yet related, water quality programs and activities, many of which have specific geographic boundaries and goals. These include but are not limited to TMDLs, Roundtables, Water Quality Management Plans, erosion and sediment control regulations, stormwater management, Source Water Protection Program, and local comprehensive plans. Coordination of the implementation project with these existing programs could result in additional resources and increased participation.

Chesapeake Bay TMDL

This project watershed is within the Chesapeake Bay Watershed Implementation Plan drainage area. Many BMPs that address bacteria reduction will also help reduce nutrients and sediment from entering the waterways (http://www.deq.virginia.gov/Programs/Water/ChesapeakeBay/ChesapeakeBayWatershedImplementationPlan.aspx). With overlapping BMP implementation goals, coordination between lead agencies and the documentation of work completed is important.

7.2 Monitoring

Improvements in water quality will be determined in the Linville Creek watershed through monitoring conducted by the VADEQ's ambient monitoring program. The monitoring data include bacteria, physical parameters (dissolved oxygen, temperature, pH, and conductivity), nutrients and organic and inorganic solids. The VADEQ uses the data to determine overall water quality status. The water quality status will help gauge the success of implementation aimed at reducing the amount of bacteria and sediment in streams of the Linville Creek watershed.

The monitoring stations in the Linville Creek watershed are listed in **Table 7.1** and shown in **Figure 7.1**. VADEQ *E. coli* stations will be monitored every other month and the VDEQ-benthic station will be monitored spring and fall within the current monitoring period. These stations are subject to change with each annual revision of VDEQ's monitoring strategy. In addition, the figure shows the location of a Friends of the Shenandoah River (FOSR) chemical monitoring station at the watershed outlet. The water quality data will be used to gauge the success of implementation as the BMPs recommended in this plan at reducing and filtering pollution. Up-to-date monitoring results are available to residents by requesting the information from the VADEQ.

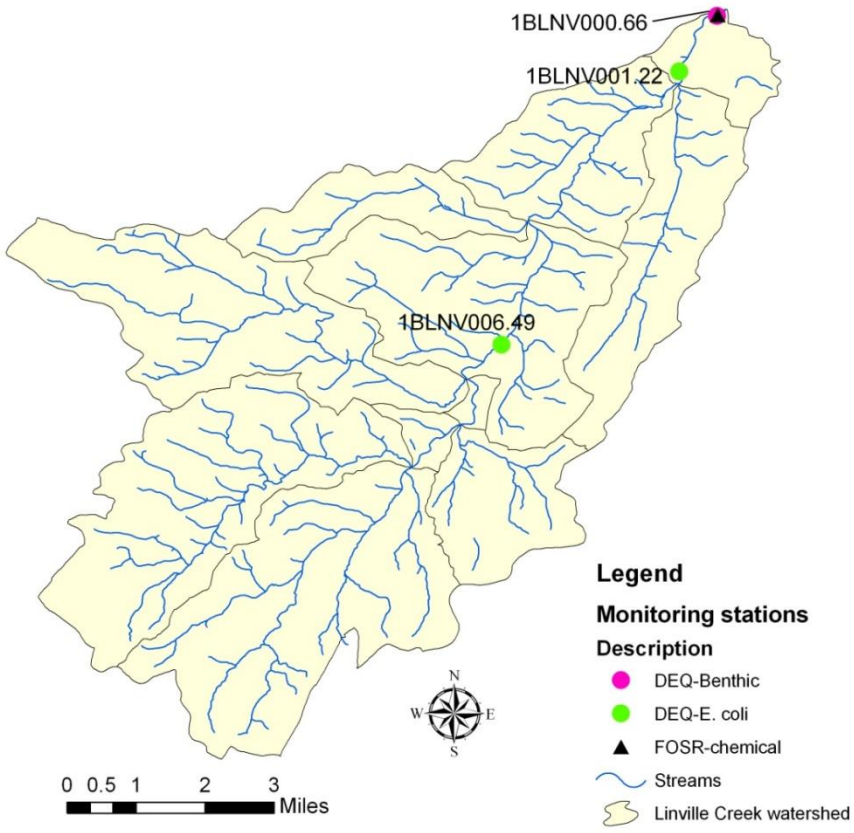


Figure 7.1 Location of monitoring stations in the Linville Creek Watershed.

Table 7.1 Monitoring station and locations for the Linville Creek watershed.

Monitoring type	Station ID*	Station description
VDEQ- *E. coli*	1BLNV006.49	Route 789 Bridge – Linville Creek
VDEQ- *E. coli*	1BLNV001.22	Route 785 Bridge – Linville Creek
VDEQ- Benthic	1BLNV000.66	Watershed outlet in Broadway – Linville Creek by Southern Railway
FOSR- Chemical	N/A	Watershed outlet in Broadway – Linville Creek by Southern Railway

7.3 Agricultural and Residential Education Programs

Education and outreach is a significant component of any TMDL implementation project. The SVSWCD will be in charge of initiating contact with farmers to encourage the installation of BMPs. This one-on-one contact will facilitate communication of the water quality problems and the corrective actions needed. The district staff will conduct a number

of outreach activities in the watershed to promote participation and community support to attain the IP milestones and to make the community aware of the TMDL requirements. Such activities will include information exchange through newsletters, mailings, field days, demonstrations, organizational meetings, and so on. The staff will work with appropriate organizations such as VCE to educate the public. Grazing land/ forage workshops possibly with the Virginia Forage and Grassland Council are venues to distribute agricultural education materials. Specific agricultural and residential outreach ideas are outlined in **section 5.3**.

A residential education program consisting of educational materials about pet waste and a pet waste composter program will be a cost-effective option. If the Master Gardener program was involved, education materials could be handed out through them. The Cooperative Extension and the SVSWCD could also help distribute information on how citizens need to clean up after their pets.

7.3.1 Shenandoah Valley Soil & Water Conservation District (SVSWCD)

The SVSWCD is a local government entity providing soil and water conservation assistance to farmers and residents in the Linville Creek watershed. During the implementation project, the SVSWCD will provide outreach, technical and financial assistance to farmers and homeowners in the Linville Creek watershed through the Virginia Agricultural BMP Cost-Share and Tax Credit programs. Their responsibilities will include promoting implementation goals, available funding and the benefits of BMPs and providing assistance in the survey, design, layout, and approval of agricultural and residential BMPs. Education and outreach activities are a significant portion of their responsibilities. Specific education and outreach methods recommended by the working groups are described in **section 5.3** of this document. The SVSWCD will be eligible for technical assistance funding to support their duties.

7.4 Legal Authority

The EPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through

legislation, incentive programs, education, and legal actions. Currently, there are four state agencies responsible for regulating activities that impact water quality in Virginia. These agencies are VADEQ, VADCR, VDH, and the Virginia Department of Agriculture and Consumer Services (VDACS).

VADEQ has responsibility for monitoring waters to determine compliance with state standards, and for requiring permitted point dischargers to maintain loads within permit limits. It has the regulatory authority to levy fines and take legal action against those in violation of permits. Beginning in 1994, animal waste from confined animal facilities that hold in excess of 300 animal units (cattle and hogs) has been managed through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent surface and groundwater contamination. In response to increasing demand from the public to develop new regulations dealing with animal waste, the Virginia General Assembly passed legislation in 1999 requiring VADEQ to develop regulations for the management of poultry waste in operations having more than 200 animal units of poultry (about 20,000 chickens) (ELI, 1999). On January 1, 2008 DEQ assumed regulatory oversight of all land application of treated sewage sludge, commonly referred to as biosolids as a directed by the Virginia General Assembly in 2007. DEQ's Office of Land Application Programs within the Water Quality Division to manages the biosolids program. The biosolids program includes having and following nutrient management plans for all fields receiving biosolids, unannounced inspections of the land application sites, certification of persons land applying biosolids, and payment of a $7.50 fee per dry ton of biosolids land applied.

VADEQ holds the responsibility for addressing nonpoint sources (NPS) of pollution as of July 1, 2013. Historically, most VADCR programs dealt with agricultural NPS pollution through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the level of participation required by TMDLs (near 100%). To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentive programs are continually reevaluated to account for this level of participation. VADCR does not have regulatory

authority over the majority of NPS issues addressed here and, as of July 1, 2013, VADEQ administers the MS4 stormwater permit program.

Through Virginia's Agricultural Stewardship Act (ASA), the Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty of up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. VDACS has only two staff members dedicated to enforcing the Agricultural Stewardship Act, and very little funding is available to support water quality sampling. The Agricultural Stewardship Act is entirely complaint-driven.

The *Emergency Regulations for Alternative Onsite Sewage Systems*, adopted in April, 2010, require that all alternative onsite sewage treatment systems in Virginia be visited at least annually by a licensed operator. However, the Virginia Department of Health (VDH) does not currently have the authority, the mandate, or the resources to require or conduct similar surveillance of all conventional onsite sewage treatment (septic) systems in the Commonwealth. (Note that, as resources allow, VDH may conduct or assist with such surveys that target localized areas of specific concern.)

Given the above limitations, VDH generally learns of failed septic systems directly or indirectly from the owners of those systems or through complaints from neighbors or other government agencies. Reports of straight pipes are less-frequently received from either source, since they are generally located in less-populated areas and are typically sited/intended to avoid detection.

When VDH receives a report of a non-compliant system, it performs a site inspection, if necessary, to verify the report. VDH then works with the homeowner to address the issue in an effective, timely and regulatory-compliant manner, generally through installation of a

septic or alternative onsite system, repair or replacement of an existing system and/or failed components of that system, connection to a central collection/treatment system, or other appropriate measures. In the case of non-cooperative homeowners, VDH initially attempts to achieve compliance through internal enforcement actions and, ultimately, through the court system.

An impasse may be reached when a homeowner is willing, but financially unable to correct the non-compliance. In such situations, VDH assists in attempting to locate funding for the needed corrections.

The state government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments, in conjunction with the state, can develop ordinances involving pollution prevention measures. In addition, citizens have the right to bring litigation against persons or groups of people shown to be causing some harm to the claimant. The judicial branch of government also plays a significant role in the regulation of activities that impact water quality through hearing the claims of citizens in civil court and the claims of government representatives in criminal court.

The local governments can play a very active role in the implementation process. For example they could promote a septic system maintenance program. This could be done by handing out literature when individuals apply for a building permit. It is recommended that Rockingham County adopt a reserve area for land parcels using on-site wastewater treatment of equal size to the approved on-site disposal system for use in the event the on-site disposal system fails. Further, the reserve area shown must be of equal capacity to the primary drain field using the same technology as the primary system. Nothing shall be constructed within the reserve area. Rockingham county and the Town of Broadway could also play an active role in the proper disposal of pet waste. When licenses for dog kennels are issued the owners should be required to produce a plan for the proper disposal of waste from the facility. Future subdivisions should be developed with sustainable growth practices that minimize of eliminate storm water runoff. Future subdivisions should be developed with sustainable growth practices that minimize of eliminate storm water runoff.

7.5 Legal Action

The Clean Water Act Section 303(d) calls for the identification of impaired waters. It also requires that the streams be ranked by the severity of the impairment and that a Total Maximum Daily Load be calculated for that stream that would bring it back into compliance with the set water quality standard. Currently, TMDL implementation plans are not required in the Federal Code; however, Virginia State Code does incorporate the development of implementation plans for impaired streams. USEPA largely ignored the nonpoint source section of the Clean Water Act until citizens began to realize that regulating only point sources was no longer maintaining water quality standards. Lawsuits from citizens and environmental groups citing USEPA for not carrying out the statutes of the CWA began as far back as the 1970s and have continued until the present. In Virginia in 1998, the American Canoe Association and the American Littoral Society filed a complaint against EPA for failure to comply with provisions of §303d. The suit was settled by Consent Decree, which contained a TMDL development schedule through 2010. It is becoming more common for concerned citizens and environmental groups to turn to the courts for the enforcement of water quality issues.

In 1989, concerned residents of Castile in Wyoming County, New York filed suit against Southview Farm. Southview had around 1,400 head of milking cows and 2,000 total head of cattle. Tests on private wells determined that the water was contaminated with nitrates traced to irresponsible handling of animal wastes by Southview. In 1990, Southview was given a notice of violations under the Clean Water Act. Rather than change their farming practices or address the contaminated wells, they ignored the warning. In 1995, after court hearings and an appeal, the case was finally settled. Southview had to donate $15,000 to the Dairy Farms Sustainability Project at Cornell University, pay $210,000 in attorney fees for the plaintiff, and employ best management practices (Knauf, 2001).

On the Eastern Shore of Virginia, an aquaculture operation raising clams and oysters, brought suit against his neighbor, a tomato grower. The aquaculture operation owner claimed that the agricultural runoff created from the plasticulture operation carried pollutants which were destroying his shellfish beds. The suit was settled out of court in favor of the aquaculture operation owner.

Successful implementation depends on stakeholders taking responsibility for their role in the process. The primary role, of course, falls on the landowner. However, local, state and federal agencies also have a stake in ensuring that Virginia's waters are clean and provide a healthy environment for its citizens. An important first step in correcting the existing water quality problem is recognizing that there is a problem and that the health of citizens is at stake. Virginia's approach to correcting NPS pollution problems has been, and continues to be, encouragement of participation through education and financial incentives.

page intentionally blank

8. FUNDING

The following practices are identified as vital to attaining the goals of the Linville Creek watershed IP: LE-1T and LE-2T (Grazing Land Protection), WP-2T (Streambank Protection in TMDL areas), CREP (Conservation Reserve Enhancement), RB-1 (Septic Tank Pump-Out), RB-3 (Septic System Repair), RB-4 (Septic Tank System Installation/Replacement), RB-5 (Alternative On-site Waste Treatment System), FR-1 (Reforestation of Erodible Crop and Pastureland), Residential Education Program. Potential funding sources available during implementation were identified during IP development. A brief description of the programs and their requirements is provided in this chapter. Detailed descriptions can be obtained from the SWCDs, VADCR, NRCS, and VCE. It is recommended that participants discuss funding options with experienced personnel at their local SWCD in order to choose the best option. Information on program description and requirements was provided from fact sheets prepared by Virginia State Technical Advisory Committee, VADEQ, and VADCR.

Federal Clean Water Act 319 Incremental Funds

Through Section 319 of the Federal Clean Water Act, Virginia is awarded grant funds to implement the nonpoint source programs. VADEQ administers the money to fund watershed projects, demonstration and educational programs, nonpoint source pollution control program development, and technical and program staff. VADEQ reports annually to the EPA on the progress made in nonpoint source pollution prevention and control.

Virginia Agricultural Best Management Practices Cost-Share Program

The cost-share program is funded with state and federal monies through local SWCDs. SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control sediment, nutrient loss, and transportation of pollutants into our waters due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Program participants are recruited by SWCDs based upon those factors, which have a great impact on water quality. The objective is to solve water quality problems by fixing the worst problems first. Cost-share is typically 75% of the actual cost, not to exceed the local maximum. The Virginia Natural Resources Conservation Fund (VNRCF) provides funding for this program as established in the state budget.

Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, shall be allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. "Agricultural best management practices" are approved measures that will provide a significant improvement to water quality in the state's streams and rivers, and is consistent with other state and federal programs that address agricultural nonpoint source pollution management. Any practice approved by the local SWCD Board shall be completed within the taxable year in which the credit is claimed. The credit shall be allowed only for expenditures made by the taxpayer from funds of his/her own sources. The amount of such credit shall not exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed, as certified by the Board. If the amount of the credit exceeds the taxpayer's liability for such taxable year, the excess may be carried over for credit against income taxes in the next five taxable years until the total amount of the tax credit has been taken. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Virginia Agricultural Best Management Practices Loan Program

Loan requests are accepted through VADEQ. The interest rate is 3% per year and the term of the loan coincides with the life span of the practice. To be eligible for the loan, the BMP must be included in a conservation plan approved by the local SWCD Board. The minimum loan amount is $5,000; there is no maximum limit. Eligible BMPs include 23 structural practices such as animal waste control facilities, loafing lot management systems, and grazing land protection systems. The loans are administered through certain participating lending institutions.

Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment

and structures to implement agricultural BMPs. The equipment must be needed by the small business to comply with the federal Clean Air Act, or it will allow the small business to implement voluntary pollution prevention measures. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. There is a $30 non-refundable application processing fee. The Fund will not be used to make loans to small businesses for the purchase and installation of equipment needed to comply with an enforcement action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point sources and nonpoint sources are administered through VADEQ. Most WQIF grants provide matching funds on a 50/50 cost-share basis. Successful applications are listed as draft/public-noticed agreements, and are subject to a public review period of at least 30 days. This fund was identified as a potential funding source for the urban stream buffers and pet waste composter program to be included in the implementation plan.

Community Development Block Grant Program

The Department of Housing and Urban Development sponsors this program, intended to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities primarily for persons of low and moderate income. Recipients may initiate activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

Conservation Reserve Program (CRP)

Offers are accepted and processed during fixed signup periods that are announced by FSA. All eligible (cropland) offers are ranked using a national ranking process. If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. Cost-share assistance is available to establish the conservation cover of tree or herbaceous vegetation. The per-acre rental rate may not exceed the Commodity Credit Corporation's maximum payment amount, but producers may elect to receive an amount less than the maximum payment rate, which can increase the ranking score. To be eligible for consideration, the following criteria must be met: 1) cropland was planted or considered planted in an agricultural commodity for two of the five most recent crop years; and 2) cropland is classified as "highly-erodible" by NRCS. Eligible practices include planting these areas to trees and/or herbaceous vegetation. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. Land must have been owned or operated by the applicant for at least 12 months prior to the close of the signup period. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration.

Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing USDA CRP Continuous Sign-up. It has been "enhanced" by increasing the cost-share rates from 50% to 75% and 100%, increasing the rental rates, and offering a flat rate incentive payment to place a permanent "riparian easement" on the enrolled area. Pasture and cropland (as defined by USDA) adjacent to streams, intermittent streams, seeps, springs, ponds and sinkholes are eligible to be enrolled. Buffers consisting of native, warm-season grasses on cropland, to mixed hardwood trees on pasture, must be established in widths ranging from the minimum of 30% of the floodplain or 35 feet, whichever is greater, to a maximum average of 300 feet. Cost-sharing (75% - 100%) is available to help pay for fencing to exclude livestock from the riparian buffer, watering facilities, hardwood tree planting, filter strip establishment, and wetland restoration. In addition, a 40% incentive payment upon completion is offered and an average rental rate of $70/acre on stream buffer area for 10-15 years. The State of Virginia will make an additional

incentive payment to place a perpetual conservation easement on the enrolled area. The statewide goal is 8,000 acres.

The landowner can obtain and complete CREP application forms at the FSA center. The forms are forwarded to local NRCS and SWCD offices while FSA determines land eligibility. If the land is deemed eligible, NRCS and the local SWCD determine and design appropriate conservation practices. A conservation plan is written, and fieldwork is begun, which completes the conservation practice design phase.

FSA then measures CREP acreage, conservation practice contracts are written, and practices are installed. The landowner submits bills for cost-share reimbursement to FSA. Once the landowner completes BMP installation and the practice is approved, FSA and the SWCD make the cost-share payments. The SWCD also pays out the state's one-time, lump sum rental payment. FSA conducts random spot checks throughout the life of the contract, and the agency continues to pay annual rent throughout the contract period.

Environmental Quality Incentives Program (EQIP)

This program was established in the 1996 Farm Bill to provide a single voluntary conservation program for farmers and landowners to address significant natural resource needs and objectives. This program replaces the Agricultural Conservation Program (ACP) and the Water Quality Incentive Program (WQIP). Approximately 65% of the EQIP funding for the state of Virginia is directed toward "Priority Areas." These areas are selected from proposals submitted by a locally led conservation work group. Proposals describe serious and critical environmental needs and concerns of an area or watershed, and the corrective actions they desire to take to address these needs and concerns. The remaining 35% of the funds are directed toward statewide priority concerns of environmental needs. EQIP offers 5 to 10-year contracts to landowners and farmers to provide up to 75% cost-share assistance, 25% tax credit, and/or incentive payments to implement conservation practices and address the priority concerns statewide or in the priority area. Eligibility is limited to persons who are engaged in livestock or agricultural production. Eligible land includes cropland, pasture, and other agricultural land in priority areas, or land that has an environmental need that matches one of the statewide concerns.

Wildlife Habitat Incentive Program (WHIP)

WHIP is a voluntary program for landowners and land users who want to develop or improve wildlife habitat on private agriculture-related lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. In Virginia, these plans will be prepared to address one or more of the following high priority habitat needs: early grassland habitats that are home to game species such as quail and rabbit as well as other non-game species like meadowlark and sparrows; riparian zones along streams and rivers that provide benefits to aquatic life and terrestrial species; migration corridors which provide nesting and cover habitats for migrating songbirds, waterfowl and shorebird species; and decreasing natural habitat systems which are environmentally sensitive and have been impacted and reduced through human activities. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Applicants will be competitively ranked within the state and certain areas and practices will receive higher ranking based on their value to wildlife. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders and hedgerows. For cost-share assistance, USDA pays up to 75% of the cost of installing wildlife practices.

Wetland Reserve Program (WRP)

This program is a voluntary program to restore and protect wetlands on private property. The program benefits include providing fish and wildlife habitat, improving water quality, reducing flooding, recharging groundwater, protecting and improving biological diversity, and furnishing recreational and esthetic benefits. Sign-up is on a continuous basis. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements of a minimum 10-year duration. Under the permanent easement option,

landowners may receive the agricultural value of the land up to a maximum cap and 100% of the cost of restoring the land. For the 30-year option, a landowner will receive 75% of the easement value and 75% cost-share on the restoration. A ten-year agreement is also available that pays 75% of the restoration cost. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities. At any time, a landowner may request that additional activities be added as compatible uses. Land eligibility is dependent on length of ownership, whether the site has been degraded as a result of agriculture, and the land's ability to be restored. Restoration agreement participants must show proof of ownership. Easement participants must have owned the land for at least one year and be able to provide clear title.

Southeast Rural Community Assistance Project (SE/R-CAP)

The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SE/R-CAP central office staff across the region. They can provide (at no cost to a community): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes $1,500 toward repair/replacement/installation of a septic system and $2,000 toward repair/replacement/ installation of an alternative waste treatment system. Funding is only available for families making less than 125% of the federal poverty level. The federal poverty threshold for a family of four is $23,283.

National Fish and Wildlife Foundation

Offers are accepted throughout the year and processed during fixed signup periods. The signup periods are on a year-round, revolving basis, and there are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. An approved pre-proposal is a pre-requisite to the submittal of the full proposal. Grants generally range between $10,000 and $150,000. Payments are based on need. Projects are funded in the U.S. and any international areas that host

migratory wildlife from the U.S. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, the proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated. A pre-proposal that is not accepted by a special grant program may be deferred to the general grant program.

Clean Water State Revolving Fund

EPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, nonpoint source and estuary protection projects. Point source projects typically include building wastewater treatment facilities, combined sewer overflow and sanitary sewer overflow correction, urban stormwater control, and water quality aspects of landfill projects. Nonpoint source projects include agricultural, silvicultural, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc. Estuary protection projects include all of the above point and nonpoint source projects, as well as habitat restoration and other unique estuary projects.

EPA Environmental Education Grant Funding Opportunity

EPA has recently announced an exciting environmental education grant funding opportunity. The purpose of the grants is to promote environmental stewardship and help develop knowledgeable and responsible students, teachers and citizens. For the full EPA news release, please visit http://go.usa.gov/4DQ. More information on eligibility and application materials, please visit http://www.epa.gov/enviroed/grants.html.

The project start date in proposals should be no earlier than September 1, 2011. There is a requirement to specify an environmental issue, based on EPA's current priorities that the proposed project will focus on. There is more emphasis on expanding the conversation on

environmentalism by including a variety of audiences in proposed projects. There is a strong emphasis on partner letters this year. Letters will be scored for their clarity and completeness. Incomplete applications will not be reviewed. If applying through grants.gov, make sure to register at least one week ahead of time. Check out the FAQ link for more information: http://www.epa.gov/enviroed/grants_faq.html.

page intentionally blank

GLOSSARY

303(d). A section of the Clean Water Act of 1972 requiring states to identify and list water bodies that do not meet the states' water quality standards.

319. A section of the Clean Water Act grant funds for MPS programs.

ACP. Agricultural Conservation Program.

Allocations. *That portion of a receiving water's loading capacity attributed to one of its existing or future pollution sources (nonpoint or point) or to natural background sources. (A wasteload allocation [WLA] is that portion of the loading capacity allocated to an existing or future point source, and a load allocation [LA] is that portion allocated to an existing or future nonpoint source or to natural background levels. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.)*

ASA. Agricultural Stewardship Act.

Best management practices (BMPs). *Methods, measures, or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.*

Bioassessment. Evaluation of the condition of an ecosystem that uses biological surveys and other direct measurements of the resident biota.

cfu. colony-forming units.

Clean Water Act (CWA). *The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The Clean Water Act (CWA) contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is Section 303(d), which establishes the TMDL program.*

Conventional pollutants. *As specified under the Clean Water Act, conventional contaminants include suspended solids, coliform bacteria, high biochemical oxygen demand, pH, and oil and grease.*

CREP. Conservation Reserve Enhancement Program.

CRP. Conservation Reserve Program.

CWA. Clean Water Act, 1972.

CWSRF. Clean Water State Revolving Fund.

DMME. Virginia Department of Mines, Minerals, and Energy.

E. coli (Escherichia coli). One of the groups of fecal coliform bacteria associated with the digestive tract of warm-blooded animals used as indicator organisms (organisms indicating presence of pathogens) to detect the presence of pathogenic bacteria in the water.

Ecoregion. A region defined in part by its shared characteristics. These include meteorological factors, elevation, plant and animal speciation, landscape position, and soils.

Ecosystem. *An interactive system that includes the organisms of a natural community association together with their abiotic physical, chemical, and geochemical environment.*

Effluent limitation. *Restrictions established by a state or USEPA on quantities, rates, and concentrations in pollutant discharges.*

Endpoint. *An endpoint (or indicator/target) is a characteristic of an ecosystem that may be affected by exposure to a stressor. Assessment endpoints and measurement endpoints are two distinct types of endpoints commonly used by resource managers. An assessment endpoint is the formal expression of a valued environmental characteristic and should have societal relevance (an indicator). A measurement endpoint is the expression of an observed or measured response to a stress or disturbance. It is a measurable environmental characteristic that is related to the valued environmental characteristic chosen as the assessment endpoint. The numeric criteria that are part of traditional water quality standards are good examples of measurement endpoints (targets).*

EQIP. Environmental Quality Incentives Program.

fecal coliform (FC). Indicator organisms (organisms indicating presence of pathogens) associated with the digestive tract.

FONFSR. Friends of the North Fork Shenandoah River.

FOSR. Friends of the Shenandoah River.

FSA. Farm Service Agency.

FTE. Full-Time Equivalents.

Geometric mean. A measure of the central tendency of a data set that minimizes the effects of extreme values.

GIS. Geographic Information System. A system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. (Dueker and Kjerne, 1989).

GWLF. *Generalized Watershed Loading Function. A watershed loading model developed to assess non-point source flow and sediment and nutrient loading from urban and rural watersheds.*

HSPF. Hydrological Simulation Program – Fortran. A computer simulation tool used to mathematically model nonpoint source pollution sources and movement of pollutants in a watershed.

Impairment. A detrimental effect on the biological integrity of a water body that prevents attainment of the designated use.

IP. Implementation Plan.

Indicator organism. *An organism used to indicate the potential presence of other (usually pathogenic) organisms. Indicator organisms are usually associated with the other organisms, but are usually more easily sampled and measured.*

LIP. Landowner Incentive program

Margin of safety (MOS). *A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody (CWA Section 303(d)(1)(C)). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by the USEPA either individually or in state/USEPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a TMDL = LC = WLA + LA + MOS).*

Memorandum of Understanding (MOU). A memorandum of understanding (MOU) may be used as a confirmation of agreed upon terms when an oral agreement has not been reduced to a formal contract. It may also be a contract used to set forth the basic principles and guidelines under which the parties will work together to accomplish their goals.

MRLC06. The Multi-Resolution Land Characterization (MRLC) Consortium which developed the NLCD 2006 dataset from multi-spectral Landsat imagery.

MS4. Municipal Separate Stormwater Sewer System.

National Pollutant Discharge Elimination System (NPDES). *The national program for issuing, modifying, revoking and re-issuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.*

NFWF. National Fish and Wildlife Foundation.

Nonpoint sources (NPS). *Pollution that originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff.*

NPSAC. Nonpoint Source Advisory Committee.

NRCS. Natural Resources Conservation Service.

OSTS. Onsite sewage treatment systems (*e.g.,* septic systems and alternative waste treatment systems).

Phased/staged approach. *Under the phased approach to TMDL development, load allocations and waste load allocations are calculated using the best available data and information recognizing the need for additional monitoring data to accurately characterize sources and loadings. The phased approach is typically employed when nonpoint sources dominate. It provides for the implementation of load reduction strategies while collecting additional data.*

Point source. *Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water stream or river.*

Pollutant. *Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (CWA section 502(6)).*

Pollution. *Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.*

Public comment period*. The time allowed for the public to express its views and concerns regarding action by the USEPA or states (e.g., a* Federal Register *notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).*

Publicly owned treatment works (POTW). *Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.*

Rapid Bioassessment Protocol II (RBP II). A suite of measurements based on a quantitative assessment of benthic macroinvertebrates and a qualitative assessment of their habitat. RBP II scores are compared to a reference condition or conditions to determine to what degree a water body may be biologically impaired.

Riparian areas. *Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants that require saturated soils during all or part of the year. Riparian areas include both wetland and upland zones.*

Riparian zone. *The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.*

Runoff. *That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.*

SE/R-CAP. Southeast Rural Community Assistance Project.

Sediment. In the context of water quality, soil particles, sand, and minerals dislodged from the land and deposited into aquate systems as a result of erosion.

Septic system. *An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.*

Sewer. *A channel or conduit that carries wastewater and storm water runoff from the source to a treatment plant or receiving stream. Sanitary sewers carry household, industrial, and commercial waste. Storm sewers carry runoff from rain or snow. Combined sewers handle both.*

Source. An origination point, area, or entity that releases or emits a stressor. A source can alter the normal intensity, frequency, or duration of a natural attribute, whereby the attribute then becomes a stressor.

SPCA. Society for the Prevention of Cruelty to Animals.

Staged Implementation. A process that allows for the evaluation of the adequacy of the TMDL in achieving the water quality standard. As stream monitoring continues to occur, staged or phased implementation allows for water quality improvements to be recorded as they are being achieved. It also provides a measure of quality control, and it helps to ensure that the most cost-effective practices are implemented first.

Stakeholder. Any person with a vested interest in the TMDL development.

SVSWCD. Shenandoah Valley Soil and Water Conservation District.

SWCD. Soil and Water Conservation District.

TDN. total digestible nutrients.

TMDL Implementation Plan. A document required by Virginia statute detailing the suite of pollution control measures needed to remediate an impaired stream segment. The plans are also required to include a schedule of actions, costs, and monitoring. Once implemented, the plan should result in the previously impaired water meeting water quality standards and achieving a "fully supporting" use support status.

Total Dissolved Solids (TDS). A measure of the concentration of dissolved inorganic chemicals in water.

Total Maximum Daily Load (TMDL). *The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, plus a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.*

Total Suspended Solids (TSS). Usually fine sediments and organic matter. Suspended solids limit sunlight penetration into the water, inhibit oxygen uptake by fish, and alter aquatic habitat.

TRC. Total Residual Chlorine. A measure of the effectiveness of chlorinating treated wastewater effluent.

USDA. United States Department of Agriculture.

USDHHS. .. United States Department of Health and Human Services

USEPA. United States Environmental Protection Agency.

Use Attainability Analysis (UAA). A UAA is a structured scientific assessment of the factors affecting the attainment of the use, which may include physical, chemical, biological, and economic factors as described in the Federal Regulations.

VADACS. Virginia Department of Agriculture and Consumer Services.

VADCR. Virginia Department of Conservation and Recreation.

VADEQ. Virginia Department of Environmental Quality.

VASCI. Virginia Stream Condition Index.

VCE. Virginia Cooperative Extension.

VDACS. Virginia Department of Agriculture and Consumer Services.

VDH. Virginia Department of Health.

VDOF. Virginia Department of Forestry.

Watershed. *A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.*

WHIP. USDA Wildlife Habitat Incentive Program. WHIP is a voluntary program for landowners and land users who want to develop or improve wildlife habitat on private agriculture-related lands.

WQIA. Water Quality Improvement Act.

WQIP. Water Quality Improvement Plan.

WQMIRA. Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or NPS management measures.

WQMP. Water Quality Management Plan.

WRP. Wetland Reserve Program.

page intentionally blank

REFERENCES

CDC. 1995. *Escherichia coli* 0157:H7 outbreak at a summer camp – Virginia, 1994. CDC *MMWR Weekly. June 9, 1995. 44(22);419-421.*

CDC. 2001. Outbreaks of Escherichia coli 0157:H7 infections among children associated with farm visits --- Pennsylvania and Washington, 2000. CDC MMWR Weekly. April 20, 2001 / 50(15);293-7. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5015a5.htm

*Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.*naturalresources.virginia.gov/Initiatives/TributaryStrategies/

ELI. 1999. Locating Livestock: How Water Pollution Control Efforts Can Use Information From State Regulatory Programs. Environmental Law Institute. Research Report 1999. ELI Project #941718.

Haith, D.A., R. Mandel, and R.S. Wu. 1992. GWLF. Generalized Watershed Loading Functions, version 2.0 User's Manual. Department of Agricultural and Biological Engineering, Cornell University, Ithaca, New York.

Knauf, A.J. 2001. The Southview Farm Case: A giant step to end special treatment for agriculture under environmental laws. Available at: http://www.nyenvlaw.com/southview.htm.

Pugh, S. 2001. Letter regarding: The Agricultural Stewardship Act and TMDLs. February 13, 2001.

Roanoke Times. 1997a. E. coli cases pit health officials against boaters, swim at your own risk. Roanoke Times. November 9 1997. Page B1.

Roanoke Times. 1997b. Meeting taps concerns over lake's water quality, some want education, others regulation, to prevent sickness. Roanoke Times. November 15, 1997. Page B1

Roanoke Times. 1998a. Confirmed E. coli count now at 9. Roanoke Times. August 22, 1998.

Roanoke Times. 1998b. E. coli levels hard to track. Roanoke Times. October 19, 1998. Page C1.

Roanoke Times. 1998c. State tests confirm E. coli infections still no source determined. Roanoke Times. August 19, 1998.

Roanoke Times. 2000. Health Dept. shuts off tap on Crystal Spring's water. Roanoke Times. June 6, 2000. Page A1.

Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.

USEPA. 1999. Guidance for Water Quality-Based Decisions: The TMDL Process. http://www.epa.gov/OWOW/tmdl/decisions/dec1c.html.

VADEQ. 1998. 303(d) Total Maximum Daily Load Priority List and Report.

VCE. 1996. Controlled grazing of Virginia's pastures, by Harlan E. White and Dale D. Wolf, Virginia Cooperative Extension Agronomists; Department of Forages, Crop, and Soil Environmental Sciences, Virginia Tech. Publication Number 418-012. July 1996. Available at: http://www.ext.vt.edu/pubs/livestock/418-012/418-012.html

VCE. 1998a. Mastitis cost? by Gerald M. (Jerry) Jones, Extension Dairy Scientist, Milk Quality and Milking Management, Virginia Tech. Dairy Pipeline. December 1998. Available at: http://www.ext.vt.edu/news/periodicals/dairy/1998-12/mastitis$.html

VCE. 1998b. Safe water for horses, questions about water testing, by Larry Lawrence, Extension Animal Scientist, Horses, Animal and Poultry Sciences, Virginia Tech. Livestock Update. December 1998. Available at: http://www.ext.vt.edu/news/periodicals/livestock/aps-98_12/aps-1005.html

VCE. 2000. Feeder and stock health and management practices, by John F. Currin and W. D. Whittier, Extension Specialists, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech. Publication Number 400-006. January 2000. http://www.ext.vt.edu/pubs/beef/400-006/400-006.html

VDCR. 2012. Program Year 2013 Virginia Agricultural Cost Share (VACS) BMP Manual. Department of Conservation and Recreation, Division of Soil and Water Conservation, Richmond, VA.

APPENDIX A: MEETING MINUTES AND PUBLIC COMMENTS

Linville Creek Residential Working Group
Meeting Summary: November 27, 2012
Linville Edom Ruritan Hall

Tara Sieber (Virginia Dept. of Environmental Quality) introduced herself to the group and gave out copies of the discussion guide, designed to help cover topics that impact sediment and bacteria contributions to Linville Creek from residential areas.

Issues with Straight Pipes

Straight pipes were seen as an important issue by the group. Jason Weakley (Health Dept.) stated that even washing machine discharge is seen as impacting waterways and needs to be fixed. Several folks in the group believed they knew of a few potential straight pipes locations – both of raw sewage or washing machine/sink discharges. The group thought that the TMDL estimate of 5 straight pipes for the entire Linville watershed was too small, so after some discussion, they raised it to 7. This will provide additional help for folks who need some assistance to fix these problems. A few of the participants in the group knew of some straight pipes that had been fixed, but a while ago.

Issues with Failing Septics

Many people had questions about septic system maintenance and repair that Jason Weakley was able to answer. It was evident to many in the group that more education was needed to make sure that homeowners understand the proper ways to take care of their septic systems. The ideas that came out of a short brainstorming session are below. The Health Dept. recommends that septics be pumped out every 3-5 years based on use and maintenance. The group discussed alternative systems, which are engineered systems for spaces where a conventional drainfield system will not work. One couple had just pumped out their system and paid between $250-350 for just the pump-out. The group estimated that when problems are found, about 40% of the replacement systems would be conventional drainfield systems and another 60% would be replaced with alternative/engineered systems.

Education and Outreach Ideas

- Getting an advocate from within the community to go after grants and spearhead some promotional efforts. The Friends of the North Fork of the Shenandoah offered to work with folks in the watershed to go after grants to help folks with septic issues and other problems. Also, the group thought that school groups could do some studies on the creek and help understand where the problems are coming from.
- Get some articles published in the North Fork Journal on well and septic maintenance
- Outreach through well-water testing, then aim for septic education/pump-outs
- The group agreed that postcards were a great way to reach folks – and cheap as well (postage for 500 recent postcards was about $120)
- Nancy Carr from the Virginia Rural Water Association has a septic model and Friends of the North Fork is making one. She will bring it to the next meeting.

- Fliers at local community boards and in local church boards can help to spread the word about meetings. Also, the Ruritan Club is a great resource and can help reach its members and the community at large.
- The group thought that including school groups in different studies of the stream would be helpful in reaching parents as well. The Elementary Schools that children attend in the area include: Linville-Edom ES, John C. Myers ES and Mountainview ES.
- A very important resource to the local area was identified at Back Home on the Farm, which is run by the Hess family. The group thought that perhaps the family could work with the community on education events or other projects.

Pet Waste

Folks in the group thought that Broadway Park already had a pet waste baggie station. A few folks were upset that there was not a town ordinance for folks to pick up pet waste; it would be nice to have one. When asked about veterinarians and kennels, folks knew of one vet in the town of Broadway that was located in the watershed, two kennels in the county, a dog agility center, and one operating groomer in Broadway that could possibly be contacted about what they do with their pet waste.

Streamside (Riparian) Plantings

A lot of people were concerned about additional regulations unfairly burdening homeowners. Some financial help should be made available for folks who want to plant trees and do stream restoration on their land. Nancy Carr pointed out that there was a residential development on the southern end of Broadway right along Linville Creek that a group could work with to help educate homeowners about not mowing to the edge of the streams, etc.

Raingardens

Tara explained a little about what a raingarden was and asked if people thought that this idea could catch on with homeowners in the watershed. Folks responded that developed areas may be a great place to encourage this type of planting – like in Broadway (there are some new developments under construction, as well as some older ones) or in the Parkview or the VMRC development in Harrisonburg. Master Gardeners and Master Naturalists may be great groups to work with to get these types of projects on the ground.

Other Ideas

Dead and fallen down trees were seen to be an issue in Linville Creek. Many times they act as a log jam, backing up trash and other debris and preventing the creek from flowing freely.

Next Meeting?

Tuesday evenings work well for another meeting in 2013. Emails and addresses were either on the Residential Working Group sign-in sheet or the Overall sign-in sheet.

Linville Creek Agricultural Working Group
Meeting Summary: November 27, 2012
Linville Edom Ruritan Hall

Agricultural Land Use

Nesha McRae provided the group with a handout that included a series of discussion questions for the group. She began by asking some general questions about agriculture in the watershed including the average size of farms in the area.

- The group agreed that on average, farms fall within the range of 200-250 acres.
- Over the past decade, there has been a slight increase in acres in corn as opposed to pasture and hay, the group estimated a 10% increase since 2003.
- There are not many absentee landowners of farms in the watershed.
- A number of farmers are renting the land that they farm. Nesha polled the group and it was concluded that about 5-10% of agricultural landowners at the meeting were renting their land to someone else.
- There has been some development pressure in the Linville-Edom area as well as in and around the Town of Broadway. It was noted that a large development just south of Broadway was approved, which includes the construction of 208 homes.
- It was suggested that as development continues to increase, it will become even more important to reach out to business owners in the watershed regarding what they can do to reduce polluted stormwater running off of their rooftops and parking lots in to the creek. The group asked Nesha to reach out to several businesses in the watershed and make sure that they were aware of the watershed planning effort underway now.

Livestock Exclusion

- Several reaches of the stream are more flood-prone than others including the stretch of stream from Singers Glen to 42. This portion of the stream has a steep gradient. Flooding also often occurs around Broadway.
- Nesha explained the different programs that are available to property owners to help with the cost of streambank fencing. For farmers who are willing to set a fence 35 feet back from the stream, there is a program that provides up to 85% cost share. If a farmer wishes to place the fence closer to the stream (10 feet), they can receive 50% cost share. Additional incentives are available for landowners who can place their fence 100 feet back from the stream and plant trees. Nesha asked the group if they had any ideas as to what proportion of farmers would be interested in the different programs. The group did not have any suggestions on how to estimate these figures.
- Drilling a well for alternative water for livestock can be very challenging in the watershed due to all of the limestone. In some areas you may have to go as deep at 1,500 feet, in other areas you will need to go to about 500 feet. This makes installing a well highly variable in terms of cost.

Pasture Management

- The group agreed that the practice of rotational grazing is catching on in the watershed.
- The average stocking rate for pasture in the area is approximately 1 cow/2 acres.

- Absorption of runoff on pastures and other non paved surfaces may be lower in the Linville Creek watershed than in other areas due to the amount of shallow rock in the area.
- Concerns were expressed by several participants about gravel wash off and stormwater runoff from roadways and suggested that VDOT needed to be involved in the watershed planning process to help determine what they could do to remedy the situation. Several farmers noted that stormwater from roadways was being directed at their property which was causing problems from a management perspective.

Manure/Poultry Litter Management

- Permitted poultry growers in the watershed are required to have storage for poultry litter in their permits. Therefore there's not much of an unmet need for litter storage facilities in the watershed. One participant expressed a concern that some poultry growers are required to have storage even though they don't need it (they are applying all that they are producing).
- There are a handful of situations where farmers are feeding right down on the stream and the area has become very denuded. In these cases, a dry stack facility for cattle manure could be used as an incentive for the farmer to relocate their feeding operation.
- Manure incorporation has been attempted in the watershed, but has not been very successful. There is too much rock, and it requires disturbance of soil on steep hills in the area. In addition, it was noted that it is not the most efficient practice due to the time and fuel demands it poses.

Cropland

- Cover crops have been a very popular practice in the watershed, though one participant expressed a concern about the planting date requirements explaining that these can be difficult to comply with.
- There is very little deep tillage on cropland in the watershed any more. It was estimated that 50-60% of farmers in the watershed are employing some form of no till practices on their farms.

Streambank Erosion

- The group agreed that streambank restoration efforts should begin in the headwaters and work their way downstream.
- There are some problem spots of bank erosion around Linville and Broadway.

Other Topics

- Local businesses with parking lots should be approached to see if they would be willing to implement best management practices to manage their stormwater.
- The next working group meeting will be held within the next 1-2 months, Nesha will notify participants.

Linville Creek Agricultural Working Group
Meeting Summary: January 20, 2013
Linville Edom Ruritan Hall

Nesha McRae (VA Department of Conservation and Recreation) began the meeting with an overview of the meeting objectives including a review of implementation scenarios and associated costs, identification of an implementation timeline and targeting strategies, and discussion of appropriate education and outreach strategies. Nesha reviewed key points from the last working group meeting and explained that these points had been considered in developing the potential implementation scenarios that the group would be reviewing.

Review of Phase I Implementation Scenario

Nesha McRae provided the group with a handout that included a series of tables including one potential BMP scenario for the first phase (Phase 1) of implementation. Nesha explained that Phase 1 should be an implementation scenario that the group feels is ambitious, but realistic.

Livestock Exclusion

- Nesha began by asking the group for their feedback on the fencing goals included in the scenario, which totaled 100% livestock exclusion.
- One participant asked whether fencing estimates included intermittent streams. Nesha explained that a small portion of intermittent streams were included based on analysis of aerial imagery. In instances where a defined channel was observed in the imagery, fencing opportunities along intermittent streams were included. It was noted that in cases where you have an intermittent stream that only runs a couple of times a year, there may be other practices like grass filter strips that would be more appropriate.
- Participants agreed that this goal of 100% exclusion was too high for Phase 1. One participant noted that due to the geology of the watershed, there may be sites where installing a fence is extremely challenging (it will be challenging to drive fence posts in areas that are covered in rock).
- Concerns will be expressed about the loss of land for grazing and the inability to flash graze buffers. The management options for buffers were discussed and one participant expressed his concern that a poorly managed buffer with trees but no grasses growing beneath them would contribute to the sediment issue in the creek.
- Nesha suggested reducing the total % of exclusion in Phase 1 to 50-60%; no objections were raised to this adjustment.
- The group discussed the different buffer widths of the fencing systems listed in the handout and several participants agreed that there may be more of an interest in the 10 foot buffer practice along portions of the stream that do not flood often. Nesha recommended reviewing opportunities for fencing along intermittent streams in the watershed and employing the 10 foot buffer practices in more of these instances. The group was in agreement with this approach.

- It was noted that there may be some portions of a farm where it makes sense to fence out the stream, and others where it does not. In addition, some farmers may prefer to do portions of fencing at a time; not the entire farm at one time. Corey Guilliams explained that farmers can do segments of the stream, but that the preference is that all of the work be completed at once.
- Owners who rent grazing to others are a problem because they have no incentive to invest in practices. The renter is not incentivized either.

Targeting in Phase 1

- Several participants noted that there are a few problem areas in the watershed that are most likely contributing disproportionately to the problem. They asked whether this plan would identify these properties. Nesha explained that the objective of the plan is not to call out specific landowners; but that we could recognize that these problem areas exist and include a series of best management practices that we know would be effective in addressing them.
- Nesha noted that some of these practices (e.g. retention ponds on pasture) had not been included in Phase 1 due to their cost, but if the group wanted to focus on addressing the worst case scenarios first, those practices could also be included in Phase 1. The group did not object to this approach and moved on to discuss the use of ponds to treat pasture runoff. While these practices are expensive, participants agreed that they can be a good solution in cases where a landowner is feeding in a denuded area that is running down to the stream. It was noted that vegetative filter strips can also help in these cases. Corey G. emphasized "sediment traps" could be used below CAFOs but not otherwise due to prohibitive expense.
- The group discussed fencing and flooding and expressed concerns about placing a fence close to a stream that frequently floods. It was agreed that these areas should be targeted with the greater setback fencing practices while the smaller feeder streams should be targeted with the 10 foot setback practices.
- It was noted that, although the water quality is improving based on recent data, the stream is still "dirty". The water quality will be checked regularly after the IP is finalized so we will know when it has improved.

Streambank restoration

- One participant noted that there are portions of the stream where banks are 8-10 feet tall with exposed soil. He asked what can be done about these situations where severe scouring is occurring at bends in the stream [and contributing to the sediment problem]. Nesha explained that natural stream channel design concepts are used in streambank restoration to allow a stream to access its floodplain and dissipate energy (reducing scour) while also depositing sediment in the floodplain rather than the stream channel.
- The group expressed an interest in the overall process of streambank restoration and the permits required to complete a project. Nesha suggested having a speaker at the final public meeting to talk about the process. Tara Sieber (DEQ) offered to follow up with DEQ staff involved in issuing permits for work in the stream.

- Nesha noted that Phase 1 of the plan currently includes just under 4,000 feet of streambank restoration. She explained that this amount was kept low due to the associated cost of the practice, but also commented that it could be increased if the group felt there would be a strong interest in doing more of this practice. The group did not express an interest in increasing this value.

Poultry Litter Management

- One participant asked about the practice of "manure storage for non permitted poultry" included in the implementation scenarios. Nesha explained that since the group felt that little storage was not needed for permitted operations at the last meeting, she only looked at operations that did not meet the threshold of animal units that would require a permit in identifying opportunities for litter storage.
- It was noted that non permitted operations are typically breeder operations that are only cleaning out their houses once a year. It was suggested that this type of operation may not have much of a need for a storage facility since they can typically apply the litter they have when they clean out their houses.
- Nesha asked if this number of practices should be decreased and the group agreed that it could come down a little, but that the cost of the practice should really be reduced since some form of storage could be very useful, just at a smaller scale than what is typical for larger permitted operations.

Implementation timeline

- The group discussed how long they thought it would take to meet Phase 1 goals for the project. One participant noted that this really depends on how effective outreach efforts are. Nesha explained that in other project areas, dedicated staff has been hired to reach out to farmers and other landowners in a watershed through mailings, phone calls, and farm visits.
- The group agreed that building trust will be very important in order to move the project forward and complete implementation in a reasonable timeline. Nesha offered that in other project areas, it has taken several years to build trust and strong interest.
- One participant asked Corey how long it typically takes to complete a practice from the time a farmer expresses and interest. Corey explained that it really depends on how fast the landowner wants to move things along. Most practices can be completed within 6 months to a year if a landowner is ready to move forward with the project. It was noted that fluctuations in funding for cost share programs may complicate things in terms of defining a timeline as well.
- The group discussed the milestones that will be used to determine if goals are met. Tara Sieber explained that DEQ will be monitoring water quality improvements throughout the implementation process and that ultimately success will be judged base on water quality improvements rather than levels of implementation completed.
- Nesha suggested a 7 year timeline for Phase 1 and the group did not object. In addition, she asked for feedback on a timeline for Phase 2 of the project but the group did not have any comments on this. Nesha offered up a 7 year timeline for Phase 2 as well, bringing the total project timeline to 14 years. She asked if participants objected

to this time frame and requested that people let her know if they had reservations and adjustments will be made.

Education and Outreach

- Nesha asked the group about opportunities for education and outreach and potential partners. She suggested working with the Chesapeake Bay Foundation and the Shenandoah Valley Grazers Network that they are initiating now in order to spread the word about grazing practices.
- Participants noted that it always helps to have food at meetings and suggested that the final public meeting include something like a BBQ or chili cookoff.
- Nesha asked how active Cooperative Extension is in the watershed and whether they would be a good partner. Several participants noted that they had worked with NRCS and Shenandoah Valley SWCD in the past. Corey Guilliams was noted by several participants as a good, trusted partner in discussions following the meeting.
- The group agreed that it would be best to hire someone from within the watershed to conduct outreach activities.
- It was asked whether poultry permits, etc. are regulatory after the IP is done? No, not because of the IP.

Next Steps

- Nesha explained that the next step will be to hold a steering committee meeting to review a draft of the plan. She asked for volunteers from the group but did not receive any. She explained that she would follow up with several participants to recruit someone from the group.
- Following the steering committee meeting, a final public meeting will be held. This will hopefully take place in April, though it depends on how long it takes to complete the draft plan.

Linville Creek Residential Working Group
Meeting Summary: February 5, 2013
J. Frank Hilyard Elementary School

Attendees

Tara Sieber (DEQ)
Alan Howard (VDH)
Mike Scanlan (MapTech)
Sandra Strawderman (Landowner)
Nesha McRae (DCR)

Meeting Summary

Nesha McRae welcomed participants and asked the group to introduce themselves. Nesha reviewed the meeting agenda and objectives with the group along with a summary from the first residential working group meeting held in November 2012. Nesha explained that the group would be reviewing potential scenarios for implementation of best management practices during this meeting, along with associated costs and a timeline for implementation. The group will also be doing some brainstorming on potential education and outreach strategies.

Discussion started with best management practices (BMPs) to address failing septic systems. Alan Howard (Health Department) noted that the number of failing septic systems estimated for the watershed seems high. He felt that he would be receiving considerably more complaints from the area if there were that many failing systems. Mike Scanlan noted that these could be systems where a failure is not very evident. Alan explained that he is basing the term "failing" on the definition the Health Department uses, which is when the system is either backing up into the home, or effluent is rising to the surface. The group discussed opportunities to connect to public sewer. Connections are limited to within the town limits of Broadway, meaning that there are very few opportunities to connect in the watershed as a whole. It was noted that areas where recent annexation to the town had occurred would be the best places to look for opportunities. The group agreed that the 10% estimate provided in the handout needed to be reduced considerably. Alan suggested that when connections are reduced, the number of alternative waste treatment systems should be increased accordingly. Mike agreed to go back and adjust the connection to public sewer estimates based on the population numbers of the particular subwatersheds where this is an option.

The group discussed targeting strategies for a septic tank pumpout program. It was suggested that older homes should be targeted with this program since they are most likely to have failing septic systems. Nesha suggested working with a student at JMU to conduct a GIS analysis of the age of homes in the watershed. Alan noted that the county tax parcel data shows the age of homes. The student could use the age classes used in the TMDL in order to develop a priority mailing list for the septic pumpout program. The group discussed goals for the pumpout program and agreed that pumping out approximately 20% of septic tanks in the watershed was reasonable, this amounted to approximately 300 systems. Tara suggested that years 1-2 of the timeline for pumpouts be adjusted to 25% and years 3-4 to 40%. This

would allow more time to establish word of mouth about the program. Alan suggested using the Rockingham Co. GIS system home ages to target pumpout mailings.

Sandra Strawderman asked about how implementation would be funded. Nesha explained that DCR receives funding from the Environmental Protection Agency to implement these plans; however, they do not have enough funding to implement all of the plans that have been developed across the state. A competitive request for grant proposals is typically issued by DCR on an annual basis. Interested organizations can apply to receive funding for both technical assistance (staff to work with landowners in the watershed) and cost share for landowners to assist with implementation of best management practices. Alan noted that engineering costs for alternative waste treatment systems typically range from $2,000-$4,000. This needs to be accounted for in cost estimates in the plan. Alan suggested installation cost was $17,000-$22,000. He also suggested moving 8 of the currently listed 10% sewer hookups to alternative systems.

The group moved on to discuss pet waste and stormwater BMPs. Nesha shared a map detailing potential locations for neighborhood pet waste stations, pet waste digesters and larger digesters for businesses such as boarding facilities and veterinary hospitals. Tara Sieber brought a pet waste digester to the meeting and showed the group how it was operated. She explained that it did not work at below freezing temperatures and noted that compost could be applied to flower gardens, but should not be applied to vegetable gardens. The group suggested that the number of digesters for individual homes be decreased and the number of pet waste stations be increased. It was also suggested that the Town of Broadway be contacted to see if pet waste stations could include both bags and disposal receptacles that would be emptied by town staff. Alan asked if the stations would be located on private property. Tara responded that often times they are attached to street signs or placed in public right of ways. Nesha suggested that the number of pet waste digesters in the 3 residential subdivisions noted on the map (Jewelry Drive, Robin Roost Court, McKinley Drive and other lots <2 acres in the watershed) be decreased from 50% of homes in these areas to 15% of homes. The group agreed to this reduction. Alan noted that the number one complaint from the homeowners association on Alger Lane is pet waste. This might be a good neighborhood to work with on the first neighborhood pet waste station.

The group reviewed stormwater management practices included in the handout. Nesha explained that the agricultural working group had expressed concerns that they were being asked to manage more and more stormwater as urban and residential areas are paved and more runoff is directed at their farms. Rain gardens and bioretention filters will help to reduce stormwater volumes and improve water quality. Nesha shared potential locations for these features including Broadway High School. Sandra suggested that the FFA would be a good organization to partner with on bioretention filter and rain garden projects. Tara also noted that at the last meeting, the residential working group recommended contacting the Garden Club or Master Gardeners to help with these sorts of projects. Nesha asked the group about the Pilgrim's Pride Corporation facility in the watershed and suggested that it would be a good site for stormwater management practices due to the large amount of pavement at the site. The group thought that it could be an egg laying facility. Nesha pointed out a large potential riparian buffer project highlighted on the map. This project could be implemented in phases beginning at the town park.

The group discussed next steps and the role of the Steering Committee. Nesha explained that the steering committee would meet once before the final public meeting to review the draft implementation plan and brainstorm about speakers and a format for the final meeting. Nesha noted that the agricultural working group suggested that the final public meeting include a BBQ at the Ruritan Club. Funds would need to be located for something like this. Sandra volunteered to serve on the steering committee, and Nesha asked Alan and Tara if they would participate as well. Sandra asked about the timeline for the remainder of the project. Mike responded that the draft implementation plan would be completed in the next month, meaning that the steering committee meeting would be held in 1 ½ to 2 months with the final public meeting shortly after that.

Linville Creek Steering Committee
Meeting Summary: April 16, 2013
Linville Edom Ruritan Hall

Attendees

Sandra Strawderman
Ross Clem
Mike Scanlan
Candace Sipos
Conrad Wyrick
Nesha McRae
Tara Sieber
Gerald Strawderman
Tiffany Severs
Cory Guilliams
Megen Dalton

Meeting Summary

The steering committee reviewed meeting objectives including completing a review of the draft water quality improvement plan and discussing plans for the final public meeting. The committee began with a review of the draft plan, starting with general comments about the document including the following:

- The Executive Summary could use more photos in order to serve as more of a standalone document that is appealing to the general public.
- More recent water quality information about Linville Creek is needed at the beginning of the Executive Summary, the data that is shared regarding the impairment listings is very old, and readers will want to know what is going on with the creek now. This information should also be made available at the final public meeting, either in a display or through a presentation.
- There are quite a few tables in the document, figures should be substituted where ever possible (e.g. pie charts, bar graphs).
- The document is very long. People reading it will want to know what they can do to help. It would be useful to summarize what people could do and who they should contact for more information. A one page stand alone document could be included in the plan outlining these things.

The committee moved on to provide more detailed comments on implementation actions and stakeholder roles listed in the plan. Comments included:

- It should be noted in the stormwater BMPs section that infiltration BMPs in Rockingham County will require a geotechnical survey in order to determine that karst is not present at the site and that soils are permeable. Engineering costs may be higher for these BMPs as a result of the survey work and additional design/engineering required in karst areas.
- It should be noted that cost share is already available for a number of agricultural BMPs through the SWCD (without having an approved TMDL implementation plan). These BMP codes (from the cost share program) could be included in BMP tables or a clause could be inserted stating that funds are available for a number of other practices.
- A graph could be included in the document showing the age classes of homes in the watershed and the corresponding likelihood of septic system failures.

- Rockingham County's stormwater ordinance and stormwater management program should be noted under stakeholder roles or under integration with other watershed plans. The new stormwater regulations should also be mentioned, either under the section on Rockingham County in Stakeholder Roles, or in the Chesapeake Bay TMDL section of Integration with Other Watershed Plans
- It would be useful to have a schematic of a rain garden showing how it works, this could be included in the stormwater BMPs section
- VA Cooperative Extension and Educational Institutions should be included under the stakeholder roles section. Local colleges like JMU and EMU are good sources for student interns, and the Governor's School and local high schools would be good partners in education and outreach events
- Regular update meetings should be included as an outreach strategy in the education and outreach section. These could include updates on water quality improvements and BMP implementation in the watershed.
- It is unclear how landowners with straight pipes can pursue financial assistance with having them replaced with a functional septic system. This needs to be clarified and could be included in the "what you can do to help" one-page document.
- BMP implementation costs could include costs to landowners and costs covered by state and federal cost share programs. An average cost share rate could also be provided to keep things simple (rather than listing cost data for each practice).

The group moved on to discuss plans for the final public meeting. Tuesdays and Wednesdays were identified as the best days of the week, and the group advised avoiding the week of the Rockingham County Fair. It was agreed that the Ruritan Hall would be the best place to hold the event and that it would be nice if refreshments could be provided. The Shenandoah RC&D was suggested as a possible funding source for refreshments. It was suggested that several farmers who had installed BMPs could speak about their experiences with these practices and answer questions from other farmers.

The committee ended with a discussion of how the information in the plan should be presented to the public. Mike Scanlan (MapTech) updated the committee on the reductions needed to meet water quality goals established in the Linville Creek TMDL study, explaining that while the sediment reduction goals could be met through reasonable implementation levels, bacteria reduction goals could not be met without addressing wildlife contributions. This includes what is needed to remove Linville Creek from the impaired waters list (meaning that it could occasionally violate the water quality standard), and what is needed to never violate this standard. In both cases, wildlife would have to be addressed. Mike explained that that is not something typically addressed in plans like these and asked the group how they thought people would feel about stopping short of the TMDL study goal. The committee agreed that this issue doesn't need to be brought front and center at the final public meeting, but that an honest and realistic summary of the issue will be needed. It should be stated that while implementation of this plan may not result in de-listing, it will greatly improve water quality in Linville Creek, making it more suitable for recreation than it is today.

Linville Creek Water Quality Improvement Plan
Final Public Meeting Summary: August 21, 2013
Linville Edom Ruritan Hall

Summary:

A final public meeting was held for the Linville Creek TMDL Implementation Plan on August 21, 2013. This project included the development of a series of implementation scenarios to meet the *E.coli* bacteria and sediment TMDLs for Linville Creek in addition to incremental water quality milestones. The draft implementation plan was presented at the meeting and made available on the Virginia Department of Environmental Quality (DEQ) website at that time.

Response to Comments Document for Linville Creek TMDL Implementation Plan Development

Introduction

A final public meeting was held for the Linville Creek TMDL Implementation Plan on August 21, 2013. This project included the development of a series of implementation scenarios to address the *E.coli* bacteria and sediment TMDLs for Linville Creek in addition to incremental water quality milestones. The draft implementation plan was presented at the meeting and made available on the Virginia Department of Environmental Quality (DEQ) website at that time. A 30-day public comment period on the draft plan was held from August 22 until September 20, 2013. During the public comment period, comments were received from Ms. Ruth Stoltzfus Jost, a local landowner in the watershed. The full text of the original comments and DEQ's response to those comments are provided below.

Comments provided by Ruth Stoltzfus Jost (September 23, 2013 – *comment period extended to incorporate these comments*)

I attended the meetings about the Linville Creek plan.

I'm concerned that we need to systematically assess where the sources are of our animal waste problem. Taking measures like stream buffers and alternative watering sources is voluntary, but knowing the extent of our problem is not. Let's find out where our problems are, then recruit volunteers to pinpoint the uninterested landowners, offer them help, information, and encouragement from their neighbors.

I'd be glad to volunteer.

DEQ Response

Thank you for your commitment to restoring water quality in Linville Creek. Establishing a network of citizen monitors in the watershed would be one way to accomplish your suggested plan of action for the creek. Citizen monitoring using Coliscan™ kits has proven to be an effective way of locating "hot spots" of bacteria in other watersheds, and could certainly be pursued in Linville Creek. In addition, biological monitoring in the Fall and Spring at several locations in the watershed could help to identify areas where excessive erosion is occurring. Several other landowners in the watershed have expressed an interest in becoming citizen monitors as well. A recommendation for the development of a citizens monitoring network has been inserted in the Education and Outreach chapter of the TMDL implementation plan. In addition, an explanation of how this data could be used by local landowners to share information with their neighbors regarding appropriate best management practices (BMPs) to address suspected pollutant sources in the watershed has been included.